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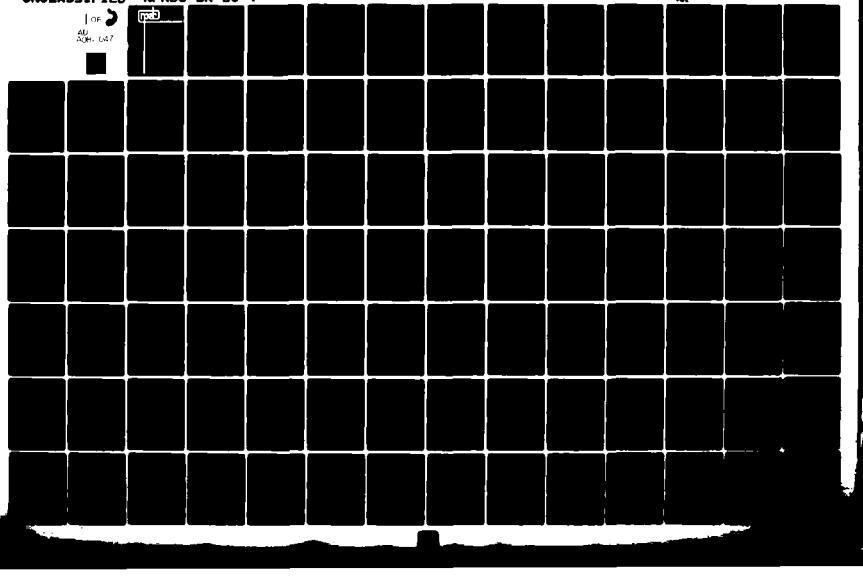

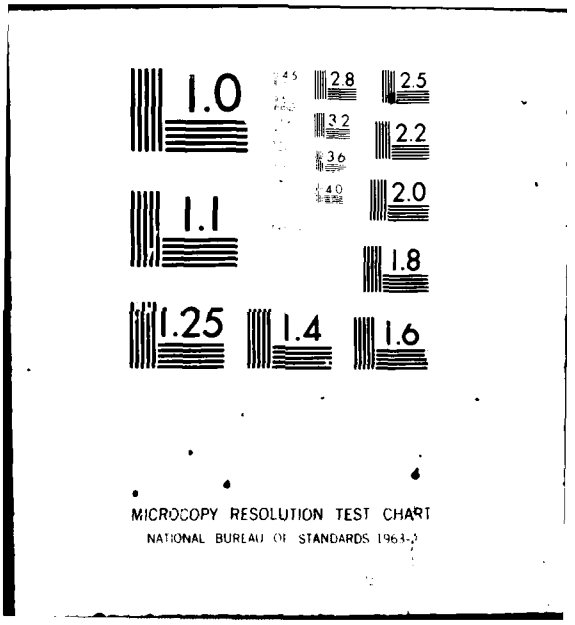
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ANALYSIS OF MARINE CORPS COMMUNICATION-ELECTRONICS SCHOOLS COMPUTER-BASED EDUCATION SYSTEM: AN IMPLEMENTATION PLAN AND ECONOMIC ANALYSIS

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ANALYSIS OF MARINE CORPS COMMUNICATION-ELECTRONICS SCHOOLS COMPUTER-BASED EDUCATION SYSTEM: AN IMPLEMENTATION PLAN AND ECONOMIC ANALYSIS

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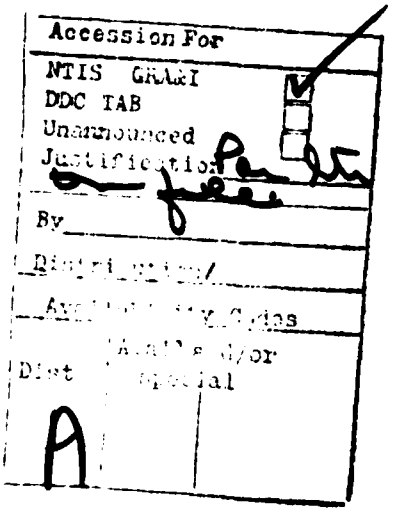
FOREWORD

The analysis represented by this report was conducted in support of the computer-based education (CBE) system being developed at the Marine Corps Communication-Electronics Schools (MCCES), Twentynine Palms, California, under the command of COL J. DePrima. An earlier draft of this report was transmitted to the Marine Corps in June 1979. With the continued support of the MCCES Command, the CBE system will be operationally implemented and could develop into a system that would serve as the standard for computer-based instructional systems in the military and civilian worlds.

The analysis could not have been conducted without the support provided by the MCCES staff in the CBE office, particularly Mr. Joe Henderson and Mr. Ray Sorenson. Special appreciation is expressed to Major W. Parker, who has been the principal developer of the CBE system. Appreciation is also expressed to Dr. Dewey Kribs, who assisted with this analysis by reviewing the implementation plan and providing summary comments that were incorporated into the final report.

DONALD F. PARKER
Commanding Officer



SUMMARY

Problem and Background

The Marine Corps Communication-Electronics Schools (MCCES), Twentynine Palms, California, is developing a computer-based education (CBE) system to support its training requirement. This CBE system is projected to provide computer-managed individualized instruction for courses concerning the operation and maintenance of communication and electronics equipment. The CBE system staff at MCCES has initiated procurement actions to acquire the computer system during FY 1980. The Navy Personnel Research and Development Center, San Diego, was tasked by Marine Corps Headquarters (Code OTT) to assist MCCES with the CBE system development.

Purpose

The purpose of this analysis is to develop an implementation plan that will be used by the MCCES staff to aid them in the development of the planned CBE system. The CBE office needed assistance in developing the strategies that are necessary for moving the instructional concept closer to the reality of an operating CBE system.

The Implementation Plan

The implementation plan is made up of a list of enabling tasks that must be accomplished to meet identified major milestones. Each enabling task has been prioritized as to degree of criticality for successful system implementation. Personnel needed to accomplish each task have been identified and classified as to their required level of expertise, according to classification levels suggested by Marine Corps personnel.

Additional information was included in the report to aid in system development. This information includes an economic analysis of the recommended CBE system as compared to current lecture instruction. Other costing information was included in the form of sensitivity analyses in the following areas: (1) percent of training time reduction resulting from individualization, (2) time to develop instructional materials, and (3) effects of variations in student load.

Major Recommendations from the CBE System Analysis

Although the initial implementation plan that was developed by the Marine Corps CBE staff is generally good, the present analyses did result in several major recommendations that would affect that plan. These recommendations have been incorporated into the implementation plan provided by this report, and are highlighted below.

1. MCCES should immediately contract a fully experienced consulting systems analyst to aid the CBE staff in the design and development of the total CBE computer system. This analyst should be highly trained in computer systems analysis and experienced with developing large-scale computer-based training systems. The estimated cost for this analyst, for approximately 1 year, is $50,000. This analyst is needed in addition to the complement of analysts already scheduled for the CBE office.

2. All computer subsystems intended for the system should be designed at the first stage of system design, even if they will not be implemented immediately. Failure to include all subsystems in the initial design phase will guarantee that either the system will not be fully functional, or the associated costs will exceed those necessary.

3. To assure quality instruction, instructional materials should be constructed by civilian professional material developers. Although instructional development costs are high, at least the first two courses scheduled for implementation--Communication Centerman's Course and Fundamentals of Digital Logic--should be developed by contract services. These contracts should be let on a competitive basis to obtain the lowest possible price. The two courses thus developed can then serve as models for other course materials to be developed by Marine Corps personnel.

4. Staffing of the MCCES billets dedicated for instructional developers, systems programmers, and operators should be accomplished on schedule or the entire system will be delayed. Deficiencies in staffing the instructional developer billets, or delays in obtaining contractors to develop materials, will significantly delay system operational capability.

5. Final test and acceptance of the vendor's computer system should be contractually based on the demonstrated adequacy of the system's operation with one course fully implemented and students under instruction. This demonstration of operation is the only way that full system operation can be assured.

6. The following courses are recommended for initial implementation into the CBE system:

a. Communication Centerman's Course (CCMC).
b. Fundamentals of Digital Logic (FDLC).
c. Basic Electronics Course (BEC).
d. Field Radio Operators Course (FROC).
e. Radio Fundamentals Course (RFC).
f. Ground Radio Repair Course (GRRC).

For these courses, all current Program of Instruction (POI) hours that are of an applied nature (e.g., laboratory, practical exercise) should be implemented for management by computer managed instruction (CMI) procedures. Fifty percent of the knowledge POI hours should be implemented via CMI, and the remaining 50 percent, using CAI, to minimize instructional development costs. The 50 percent estimate is a generalization applied across the variety of courses and should be refined as materials for specific courses are developed.

7. Research and development efforts that should be accomplished to make the recommended CBE system functional include the following:

a. Development of a CMI Instructor Training Package, estimated to cost approximately $35,000.

b. Development of the evaluation system to determine CBE cost-effectiveness. Estimated cost is approximately $55,000.

8. Manpower requirements should be analyzed to determine those needed to develop and operate the CBE system. This analysis should be performed after the specific vendor has been selected and the specific system acquired through the procurement procedures.

Conclusions

The MCCES CBE staff is progressing toward development of a computer-based training system that will satisfy normal and full mobilization MCCES training requirements in a cost-effective manner. Continuing support from MCCES and Marine Corps Headquarters, and the willingness to commit the necessary resources, is needed to enable this major instructional systems development task to be completed successfully. No matter how dedicated the CBE staff is to this effort, substantial personnel and dollar resources must be committed to complete the necessary tasks of instructional system design, instructional material development, and computer programming.

If these resources are made available, the MCCES CBE system could become the standard for large-scale, computer-based training for years to come. If successfully developed, the CBE system may be suitable for implementation in other Marine Corps training locations. This CBE system also has the potential for providing training at the various Reserve Training Centers within the Marine Reserve establishments. The decision to place similar systems at other sites must wait, of course, until the MCCES system has been successfully completed.

CONTENTS

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INTRODUCTION

Problem and Background

This report represents the result of an analysis of a computer-based education (CBE) system now under development at the Marine Corps Communication-Electronics Schools (MCCES), Twentynine Palms, California. It is intended, with its implementation plan and economic analysis, to serve as a working document to assist those charged with the task of turning a concept into an operational computer-based instructional (CBI) system that will manage the progress of almost 2000 students daily. These students will be using computer-managed and assisted instruction to acquire the skills and knowledges associated with a variety of communication-electronics skills used by the Fleet Marine Force (FMF).

MCCES is the largest formal school complex in the Marine Corps. The schools conduct approximately 45 technical training courses largely in the areas of operation and maintenance of communications and electronics equipment. MCCES has an average daily load of 1700 students in lecture-type courses that vary in length from 2 to 35 weeks.

As electronics technology has become more sophisticated, the equipment used by FMF personnel has become increasingly complex in its operation and maintenance. As a result, the training requirement for use and maintenance of the equipment has also become more complex. During this same period of increasing technological complexity, training support has declined. Inflation has had its negative effect by increasing training operation and support costs. All of these factors have placed a squeeze on the military training community. It is not surprising that the training establishment has sought remedies to the dilemma of increasing training requirements and decreasing training resources.

MCCES has attempted to resolve these problems by turning to advanced instructional technology involving computer-based instruction. The initial attempt at incorporating computer-assisted instruction (CAI) into the communication-electronics schools occurred in 1973, with UNIVAC providing 60 CAI terminals and supporting software to MCCES. Despite major data transmission problems, due to the off-site central processor, sufficient data were obtained to justify a major alteration of the training system. Since the off-site processor for that system is no longer available to MCCES, its continued use is not feasible.

Accordingly, MCCES is proceeding to develop an expanded computer-based education (CBE) system through a major procurement action. MCCES established a CBE office that has guided the procurement process to the point that a "Request For Proposals" has been released and vendors are working to develop systems responsive to the system specifications and submit proposals. At present, it is expected that the contract will be awarded early in FY 1980. MCCES is working to acquire, develop, and implement the CBE system by August 1980.

The CBE system envisioned by MCCES will provide computer-managed instruction (CMI) features, ultimately for all courses. More importantly, it will provide combined CAI/CMI instruction for selected high student-throughput courses in order to capture the sizable potential savings made possible

by individualized, self-paced instruction. Students in courses on the CAI/CMI system will receive much of their training on an individualized basis directly from the computer, including receiving instructions, taking tests, and receiving remedial study assignments. Students in courses not yet individualized will take tests that are automatically scored and will have their progress monitored by the computer. The CBE system will significantly enhance the management capability of MCCES. This should enable the school complex to provide better training management with fewer training support personnel.

Purpose

The purpose of this analysis is to develop an implementation plan that will be used by the MCCES staff to aid them in the development of the planned CBE system. The CBE office needed assistance in developing the strategies that are necessary for moving the instructional concept closer to the reality of an operating CBE system. This need for assistance was supported by Headquarters Marine Corps (Code OTT) and resulted in the analysis contained in this report.

RECOMMENDED CBE SYSTEM IMPLEMENTATION PLAN

Approach

The approach taken in developing this recommended implementation plan involved: determination of the extent of CBE system development, familiarization with MCCES training requirements, development of a tentative CBE system implementation plan, and then completion of preliminary cost analyses to determine where the plan needed modification to result in a cost-effective CBE system when compared to current lecture instruction. It was our intent to develop a system plan that, if followed, would result in an instructionally successful CBE system that would also be cost effective.

The implementation plan is presented in detail in Appendix A as Enabling Task Statement sheets. Each sheet presents a separate enabling task, and provides, to the extent possible: beginning and completion dates, the performing organization element, the required level of expertise, and estimated costs, in addition to the task statement. Generating estimated man-years and costs for many of the enabling tasks was beyond the scope of this project; in fact, such data cannot be derived until after the computer system is selected. The rating scales used to estimate the level of expertise required for personnel to perform tasks and the priority level of each task are described in the following section.

Prioritization and Required Expertise Rating Scales

The prioritization scale was developed to provide an indication of the relative importance of each enabling task in assuring the initial and the full implementation of the CBE system. Meeting the objective of successful initial implementation requires having CBE systems fully designed and substantially developed, but only partially implemented and operational. This degree of implementation and operation requires having two courses with full instructional and management capabilities on the system, with a third course having student registration, automated test scoring, and management record-keeping capabilities. By meeting this standard of initial implementation, the MCCES CBE system will have demonstrated its full CAI capabilities in two courses involving maintenance and operation training requirements. Its CMI capabilities will be demonstrated in the third course to the extent of being able to track the instructional progress of students in other courses that have not yet had the full benefit of individualized instructional development. Full system implementation calls for all six designated courses to be implemented and operated in a CAI/CMI mode, with the remaining courses being operated in a CMI mode supporting student registration, test scoring, record keeping, and management tracking.

Each enabling task listed in the implementation plan was rated according to its relative priority in terms of whether it is required for (1) initial system implementation, (2) full system capabilities but not full implementation, or (3) full system implementation.

To provide MCCES with information about the level of expertise required by personnel performing each enabling task, an expertise rating scale, supplied by Marine Corps personnel, was applied to each task. The complexity of each task was evaluated and is indicated in terms of the extent to which MCCES resources can accomplish the task. These levels of expertise and their corresponding alphabetic code used on the task sheets are as follows:

A--Can be accomplished by MCCES personnel presently available within currently authorized assets.

B--Can be accomplished by MCCES personnel but would require augmentation of the MCCES T/O.

C--Can be accomplished by MCCES personnel with the assistance of outside professional consultants.

D--Can best be accomplished by a professional contractor.

Enabling Task Statements

Figure 1 illustrates the interrelationships among the many developmental tasks. The detailed information contained on the enabling task statements in Appendix A will aid the CBE office in developing a cost-effective computer-based training system that will satisfy MCCES training requirements and be fully accepted by the Marine Corps training community.

The enabling task statements are divided into categories of activities to meet the following seven functional objectives that are necessary for successful system development:

1. Enlist the participation of training personnel to obtain system acceptance.

2. Design the CBE system.

3. Develop the computer software system.

4. Operate the CBE system.

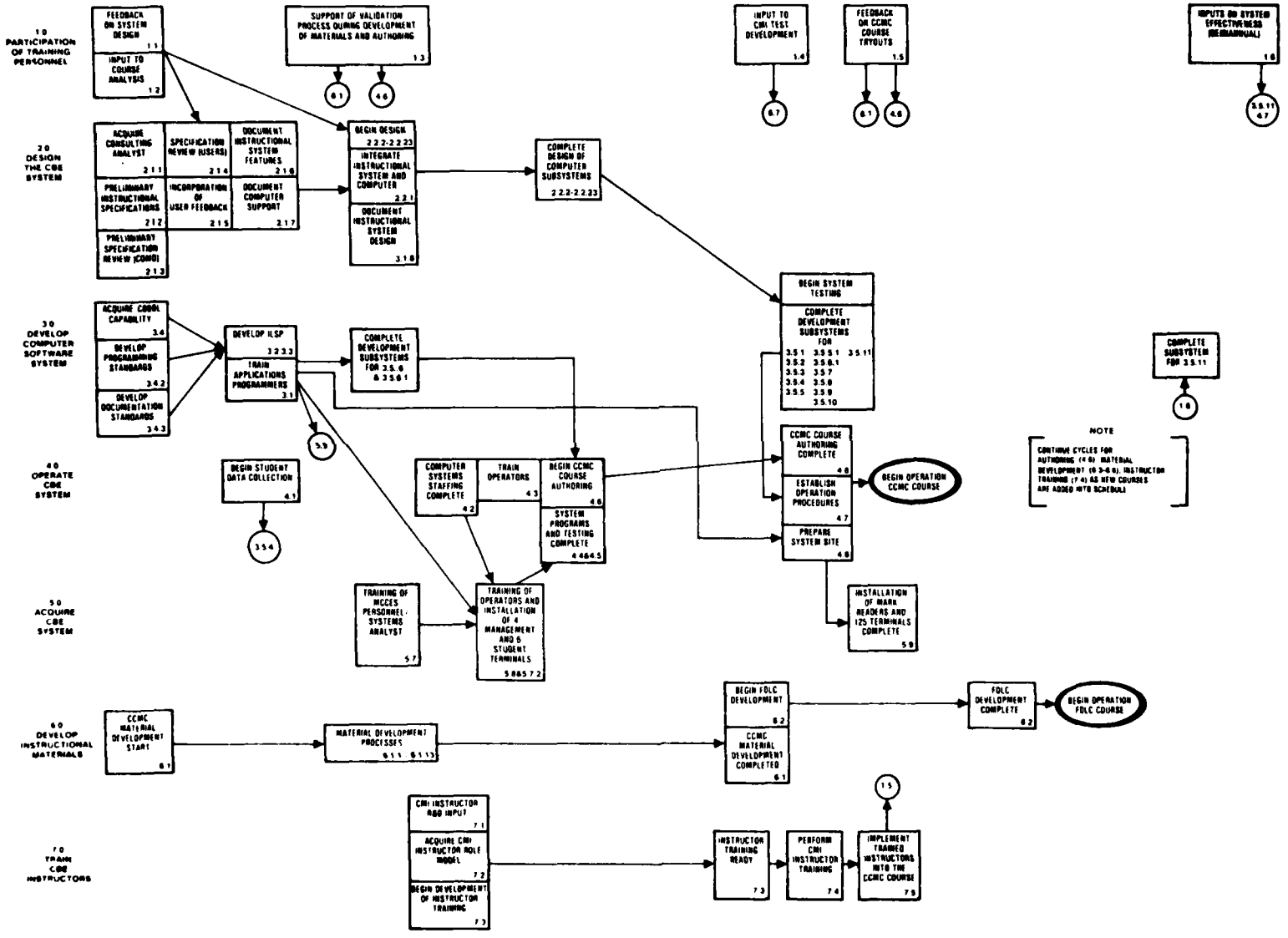
5. Acquire the CBE system.

6. Develop instructional materials.

7. Train CBE instructors.

Enabling tasks clustered under one functional objective may be completed by different individuals or organizations, but the activities are all directed at meeting that objective. The functional objectives are listed in the chronological order in which they would occur, except for objectives (4) and (5), which were reversed to keep the task listings consistent with other Marine Corps planning documents.

Figure 1. Major CBE System Development Tasks and Dependency Relationships



Each task is described with a task statement, and numbered to indicate its sequential relationship to its complementing task for that objective. As indicated earlier, each task is prioritized in terms of its importance to achieving: initial system implementation by August 1980 (Priority 1); full system capability (Priority 2); and full system implementation (Priority 3). The level of expertise required by performing individuals is indicated in accordance with the classifications suggested by Marine Corps personnel. Additional relevant information about required expertise is also included. Where possible, beginning and completion dates are provided, along with estimated man-years for the effort and/or estimated costs. Many of these estimates cannot be made until the actual computer system is selected. Following those estimates, comments are provided on the sheet relevant to that particular enabling task, if they are appropriate.

To arrive at a CBE system plan that would be as cost effective as possible when compared to current instruction, it was necessary to alter various phases of the plan and to perform additional cost analyses. As with most computer-based instructional systems, there are major areas where sizable savings are possible; for example, reductions in training time. These savings are partially offset by increased instructional materials development and computer costs. Even now it is possible, with judicious care, to further reduce the actual cost of the proposed CBE system and to arrive at a system with a greater degree of cost avoidance. The section on sensitivity analyses addresses these areas, which should receive continued command attention.

The economic analysis presented in the next section should be considered a model against which future actual costs can be compared. In addition to the economic comparison of the recommended CBE system with current lecture instruction, information was included that points out some of the cost differences that might occur if similar training requirements were implemented with self-paced individualized instruction, but without benefit of the computer.

To point out to MCCES how major system cost-drivers can affect system costs in both positive and negative directions, we have included three sensitivity analyses. These analyses demonstrate: (1) what can happen to costs when the percent reduction in training time due to individualization varies, (2) how development costs change when time to develop instructional materials varies, and (3) how student cost reductions can vary when the number of student entries is altered.

Implementation Milestones

A list of milestones is provided to describe the chronological completion of major accomplishments that are a part of the CBE system development effort. The milestones are listed in the order they should occur, along with the appropriate enabling task number for referencing back to the implementation plan. The milestones that are included represent the completed development of major system components and are of vital importance to system success.

Task No.	Milestone	Completion Date
2.1.1	Hire consulting systems analyst	July 1979
1.1	MCCES training personnel participate in evaluation of proposed CBE system.	August 1979
6.1.2	Complete training of personnel as instructional developers.	August 1979
5.6	Award the system contract.	November 1979
2.1.8	Complete design of instructional system.	December 1979
5.7	Complete vendor training of MCCES personnel in authoring language.	December 1979
5.7.1	Complete vendor training of CBE system analyst.	December 1979
7.2	MCCES receives CMI instructor role model from contractor.	January 1980
5.7.2	Complete vendor training for system operators.	February 1980
5.8	Vendor installs initial equipment: 4 management terminals and 6 student terminals.	February 1980
2.2	Complete design of computer software system.	March 1980
4.4	Complete installation of applications software programs onto the new computer system.	April 1980
7.3	Complete development of CMI instructor training package.	June 1980
6.1	Complete implementation of CCMC instructional materials onto the CAI system.	June 1980
3.5	Complete development of computer software systems.	July 1980
7.4	Complete training of personnel as CMI instructors.	July 1980
5.9	Vendor installs equipment: 2 OMR's and 125 student terminals.	August 1980
7.5	Complete placement of trained CMI instructors into CCMC course.	August 1980
4.9	Operate the CBE system with the CCMC course online.	August 1980
1.5	Obtain reaction from training personnel about initial system operation with CCMC.	August 1980
6.2	Complete implementation of FDLC onto system.	October 1980

Task No.	Milestone	Completion Date
3.5.11	Complete development of CBE system cost-evaluation monitoring subsystem.	January 1981
6.3	Complete implementation of BEC onto the system	July 1981
5.10	Vendor installs balance of equipment: 2 OMR's and 116 student terminals.	July 1981
6.4	Complete implementation of FROC on system.	June 1982
6.5	Complete implementation of RFC on system.	July 1983
6.6	Complete implementation of GRRC on system.	June 1984
6.7	Complete implementation of courses onto the CMI system of CBE.	August 1984

ECONOMIC ANALYSIS OF THE CBE SYSTEM AND CURRENT LECTURE INSTRUCTION

An economic analysis was conducted to assess the cost effectiveness of the CBE system under development by MCCES relative to the current lecture method of instruction (referred to as "conventional instruction" (CI)). The criterion for identifying the cost-effective method of instruction was defined in terms of least cost, assuming equal training effectiveness. This assumption does ignore the possible positive benefits from individualized learning such as allowing for different learner styles and abilities. Life cycle cost (LCC) estimates were developed for the CBE system configuration.

This analysis differs from previous economic analyses that were conducted by MCCES personnel and revised by the Naval Training Equipment Center (NTEC). Results of these analyses, which compared the cost effectiveness of specific CAI hardware configurations to the current lecture method of instruction, were used to justify expansion of the existing "CAI" system. Another major difference between the present and previous studies is the set of courses identified for CBE implementation. Specifically, earlier analyses considered the Basic Electronic/Fundamentals of Digital Logic Course (BEC/FDLC), the Radio Fundamentals Course (RFC), and the Technician Theory Course (TTC); whereas, this analysis evaluated the Communication Center Mass Course (CCMC), BEC/FDLC, FRDC, RFC, and the Ground Radio Repair Course (GRRC).[1]

MCCES later revised the NTEC economic analysis to provide Headquarters, Marine Corps with further information on expansion of the CBE system.[2] Information was provided on revised course schedules, terminal requirements, system design, benefits and revised cost estimates, PERT charts, and reduced CAI instructor manning. The present analysis assumed a $1.8 million ADP equipment/software procurement action based on a 3-year acquisition plan outlined in the revised MCCES economic analysis.

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[1]The original economic analysis was referred to in Commanding General, Marine Corps Base, Twentynine Palms, CA ltr C-E/ACAD:GHS:MT/5200, Enclosure (1) "Economic Analysis of Computer Assisted Instruction (CAI) at Marine Corps Communication-Electronics Schools MCCES," of 24 March 1976. The revised NTEC economic analysis was forwarded to MCCES in CO NTEC ltr N-231:wbe of 20 July 1976. MCCES submitted the revised analysis to Commandant of the Marine Corps (Code OTTS), Headquarters, U.S. Marine Corps as enclosure (1) of Commanding General, MCB, Twentynine Palms, CA ltr C/E:ACAD:RGH:hg, "Updated Economic Analysis for Expansion of Computer Assisted Instruction for the Marine Corps Communication-Electronics Schools in accordance with SECNAV INSTR 7000.14B," of 13 October 1976.

[2]Commanding General, MCB, Twentynine Palms, CA ltr C/E:ATS:RHS:bjm, "Economic Analysis of Computer Assisted Instruction (CAI) at Marine Corps Communication-Electronics Schools MCCES; revision of," of 13 April 1977.

Background

In a CI mode, students complete training as a group, progressing at the same pace for an established period of time commonly referred to as "course length." An alternative to CI is self-paced individualized instruction, which can be delivered with or without computer support. CBE refers to an instructional delivery system comprised of computer-managed instruction (CMI) and computer-assisted instruction (CAI). The term "computer-managed instruction" is used for this system to describe a mode of instruction that uses a computer to assign students to instructional lessons presented away from the computer, allocate resources, administer and score tests, assign remedial training as necessary, predict individual course completion times, and maintain administrative records on student performance and progress as well as instructor records. In CAI, the student interacts directly with the computer for instruction through a computer terminal. The computer presents lessons, tutors and tests students, and performs those functions associated with CMI.

Although it is generally accepted that course length can be reduced by CAI/CMI using individualized self-paced study, the contribution of the computer component itself toward additional reductions beyond those attained from self-pacing without computer is unknown. Obviously, self-paced instruction without computer support sacrifices the management benefits of CMI. An unresolved issue is whether or not training requirements could be satisfied using self-paced instruction on a large scale without computer management. Because the examination of this issue was beyond the scope of this analysis, the present report does not address this issue directly.

The implementation plan recommended by NAVPERSRANDCEN includes development of an additional capability that is designed to provide MCCES management with information on system cost effectiveness. This capability would provide automated data storage/retrieval procedures that will allow accurate costing of all different instructional methods used by MCCES by maintaining appropriate records on the same data base. Since this capability does not presently exist, information necessary for evaluating cost implications for CBE and current instructional procedures was collected from various MCCES offices. In some cases where data were limited, the principles of materiality (i.e., the time and cost necessary to develop reliable cost estimates exceeds the practical value of the cost information in comparing and selecting among alternatives) was invoked. Cost elements were not excluded where the omission of cost information would significantly affect LCC estimates.

It should be recognized, however, that a number of confounding variables (e.g., student aptitudes, trained personnel requirements, and instructor staffing) may cause estimated and actual costs to diverge when the CBE system is operational. For example, potential reductions in student or instructor costs may or may not be realized for a number of reasons. Under CBE and individualized instruction, or self-paced instruction without computer support, it is generally accepted that students complete training faster, thereby reducing costs incurred by personnel while in training status. These reductions are viewed as a training cost avoidance, since military trainees are placed in a productive job assignment, although

on-the-job training typically continues. Training status is viewed as essentially nonproductive because a trainee contributes little or nothing to force capability. Reduction in course length also creates an opportunity to lower instructor staffing requirements. To illustrate, the computer may create an opportunity to substitute lower ranking technicians or administrative personnel for instructors as well as to reduce the number of instructor billets. Of course, the computer does introduce new personnel costs such as the cost of systems analysts and computer programmers. These kinds of manpower tradeoffs are difficult to quantify without detailed manpower studies that consider the impact of shortened course length on the manpower staffing requirements of both individualized instruction and CBE. Additional management benefits that accrue to CBE include a greater capability to monitor training and instructional material effectiveness, and to evaluate effectiveness in terms of job performance. These benefits are also difficult to quantify. It should be noted that even now the CBE section is already providing instructional support through limited test scoring.

Economic Analysis

The proposed MCCES CBE system and the current lecture method of instruction are compared in terms of life cycle costs (LCC) for FY 1980-89. The CBE LCC estimate also reflects initial start-up costs for FY 1979. Course costs incurred during CBE implementation are time-phased corresponding to dates set forth in the implementation plan.

The cost of CI and CBE was estimated using constant FY 1979 dollars and a LCC estimate was developed by aggregating research and development investment, and operation and support costs. The training effectiveness of each alternative, measured by student achievement or on-the-job performance, was assumed to be equal. Cost estimates were developed based on information provided by Marine Corps personnel during a week-long data collection visit to the MCCES command. A list of technical and cost data elements considered in the analysis is contained in Appendix B.

Annual cash flows for FY 1980-89 were discounted to present value using a 10 percent discount rate.[3] Present value differential cost (i.e., present value CI costs minus present value CBE costs) is the relevant measure of least cost. This measure takes into account the time value of money. Because the economic life of each alternative is equal, calculation of uniform annual cost is omitted. The assumptions on which these cost estimates are based are described below. The reader should become familiar with these assumptions since changes in them would affect LCC estimates.

Assumptions

Economic Life. The economic life of CI and CBE is assumed to be 10 years. This time period is consistent with the economic life used in

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[3]SECNAV INSTR 7000.14B, "Economic Analysis and Program Evaluation for Resource Management," 18 June 1975.

earlier analyses and Marine Corps' plans to use the computer hardware and software for 10 years.[4] The economic life of the CBE system starts in FY 1980 when reductions in training time and student costs begin to accrue.

Course Length Reduction. This variable is defined as the difference between the time required to complete training for a given course under CI and the average time students would take to complete this training under CBE. Variable course length factors of 20, 32, and 44 percent were applied to the CI course length for each of the six courses to arrive at average CBE course completion times. The most reasonable estimate is 32 percent, which represents an average course length reduction found in a comparison of several CAI/CMI studies.[5] This estimate was used in the economic analysis. The 20 percent and 44 percent figures were used in a sensitivity analysis.

Man-hour Conversion Factors. The amount of time required to implement CBE is assumed to vary with the amount of CAI and CMI capabilities. Program of Instruction (POI) hours were identified as either knowledge-related or performance-related. According to the CBE implementation plan, conversion of knowledge-related POI hours will be divided equally among CAI and CMI functions, while all performance-related POI hours will be converted to a CMI function. Long, moderate, and high conversion factors were used to provide a reasonable range of instructional materials development costs. Man-hour conversion factors were specified as shown in Table 1. The moderate man-hour conversion flow was used in the economic analysis of CBE and CI. The higher and lower values, viewed as contingency assumptions, were used in the sensitivity analysis to determine how instructional development costs might vary.

Table 1

Estimated Hours for Material Development
Per Hour of CAI or CMI Instruction

	Low		Moderate		High	
Mode	Author	Code	Author	Code	Author	Code
CAI	75	25	100	50	150	75
CMI	75	10	100	20	150	30

[4]Director of Training, Headquarters, U.S. Marine Corps (Code OTTB), "Front End Analysis to Develop an Implementation Plan for the Computer Based Education (CBE) System at the Marine Corps Communication-Electronics Schools (MCCES)," 13 February 1979.

[5]Orlansky, J., & String, J. Cost-effectiveness of computer-based instruction in military training (IOA Paper N P-1375). Arlington, VA: Institute for Defense Analysis, April 1979.

Man-year Conversion Costs. A representative pay grade of E-6 was used for costing military personnel services associated with CBE instructional materials development. The composite standard military rate for E-6 Marine Corps personnel is $12,704.[6] This rate does not reflect military retirement, leave, holiday, and other personnel overhead costs. The E-6 cost factor approximates the average cost of military and civilian instructors ($12,800) presently assigned to the six courses selected for CBE implementation. Direct man-years required to author and code CBE instructional materials were costed using the E-6 cost factor. Man-year requirements were computed by dividing estimated course development man-hours by the number of direct man-hours in a man-year. The number of direct military man-hours per man-year is about 1693 hours. This estimate is based on 52 40-hour work weeks less time off for leave (173 hours), holidays (72 hours), rifle range (72 hours), and miscellaneous duties (104 hours). Direct man-hours in a civilian contractor man-hour is assumed to equal 1920 hours (i.e., 48 40-hour work weeks).

Personnel Costs. Personnel costs are comprised of military and civilian personnel costs. Composite standard military rates for Marine Corps personnel were used to estimate military instructor and student costs. Instructor costs were computed using the E-6 composite standard military rate; and student costs, by multiplying the number of students per pay grade by the appropriate composite standard military rate. Percentage distributions of students by pay grade were derived for each course using sample data extracted from rank breakdown reports for October 1978 through February 1979. The assumption was made that these distributions would remain constant for FYs 1980-89. In addition, these distributions were extrapolated to CBE courses. Civilian personnel services were costed using general schedule rates, assuming each grade had a step-5 level on the average. The general schedule rate was accelerated by 29 percent to account for leave and benefits such as retirement and insurance.

Student Entries. The number of students entering training in a given fiscal year fluctuates for various reasons such as trained personnel requirements and attrition rates. High and low student flow scenarios were developed for each course to allow for variable student entry conditions. These scenarios are based on FYs 1977-80 MCCES formal school schedules which list total quotas, or student entries, for MCCES courses. A high student flow condition in any 1 year would be about 5000 trainees; and a low flow condition, about 4200 students. The assumption was made that either a high or low flow condition would prevail throughout FYs 1980-89. This approach assumes that all students entering training would graduate; that is, zero attrition. Incomplete attrition data for several CI courses and no attrition data for CBE courses did not permit an evaluation of attrition costs. As a result, student cost estimates are slightly overstated. This is inconsequential since attrition costs probably would be almost equivalent under CBE or CI. Annual and life cycle student costs are detailed in Appendix C.

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[6]NACOMPT NOTE 7041, "Composite Standard Military Rates," 6 December 1978.

Omission of Sunk Costs and Common Costs. Sunk costs (i.e., costs incurred as a result of irrevocable decisions) and common costs (i.e., costs incurred to support two or more activities or alternatives) were omitted from the analysis. Since CI is fully operational, past expenditures for research and development and investment were treated as sunk costs. Furthermore, no future research and development nor investment costs are planned for FYs 1979-89 under the current lecture method of instruction. Costs considered as common costs included: training overhead costs, base support costs, and temporary additional duty costs. To obtain an idea of other excluded costs, refer to Appendix B.

Cost-estimating Equations

LCC is composed of three cost categories: research and development, investment, and operation and support. Component cost estimates were derived using appropriate equations that represent functional relationships between the dependent variable (cost) and independent variables. Table 2 presents equations used in determining fiscal year costs for each cost element. Component LCC estimates were obtained by aggregating projected fiscal year costs for each cost element across the six courses.

System Cost Estimates

The analysis of CI and CBE LCCs was based on several key assumptions concerning course length savings, man-hour conversion factors, and student flow scenarios. Different values were specified in order to measure the sensitivity of CBE cost projections to changes in expected course length reductions, man-hour conversion requirements, and the number of students entering training. The economic analysis assumes: (1) an average 32 percent reduction in CBE training time compared to CI course length, (2) 150 man-hours for conversion of a POI hour to CAI and 120 man-hours for conversion of a POI hour to CMI, and (3) a high annual student flow of about 5000 trainees. LCC projections developed using these values provide the most reasonable estimates for the comparing costs of CBE and the current lecture method.

Results of this discounted LCC analysis indicate that CBE is the preferred alternative based on the least-cost criterion, as shown in Table 3. The estimated present value differential costs associated with the recommended CBE system configuration is about $5.5 million. This finding means that CBE may be cost effective only if the original assumptions are met and only when compared to the current alternative CI.

Nondiscounted costs of CBE and CI are presented in Table 4. In nondiscounted terms, CBE results in a training cost avoidance of approximately $12.2 million. Approximately 92.4 percent of the LCCs traceable to CBE (i.e., excluding the CI cost share incurred during CBE implementation) are accounted for by recurring annual operation and support costs. CBE research and development and investment costs account for about 0.4 and 7.2 percent of nondiscounted LCCs respectively.

Table 2

Cost Estimating Equations by Cost Element

Cost Element	Equations
Course Development	$CD = \left[\frac{[.5K\ (CAI + CMI) + (P)\ (CMI)]}{MH} \times AMC \right] + MC$ where: CD = CBE course development costs %K = Number of knowledge-related POI hours under CI for each course %P = Number of performance-related POI hours under CI for each course CAI = CAI man-hour course conversion factor CMI = CMI man-hour course conversion factor MH = Number of direct man-hours per man-year AMC = Average E-6 man-year cost MC_i = Material costs per year
CMI Test Coding	T = MY x AMC where: T = Cost of coding course tests on computer MY = Estimated man-year to code tests on computer AMC = Average E-6 man-year cost
Initial Instructor Training	IT = ID + (I x CL x MW) where: IT = Initial CBE instructor training costs I = Number of CBE instructors ID = CBE instructor training initial course development ICL = Course length of initial training in weeks MW = Average cost per E-6 instructor man-week
CBE Section	CBES = MP + CP + PS + S where: CBES = CBE section costs MP = Cost of military personnel services CP = Cost of civilian personnel services PS = Budget cost of purchased services including computer maintenance and other miscellaneous costs S = Budget cost of supplies/consumables
Instructor Costs	IC = I x AIC where: IC = Instructor costs I = Number of instructors assigned AIC = Average instructor man-year cost
Recurring Instructor Training	$RT = \left(\frac{I}{LA}\right) \times CL \times MW$ where: RT = Cost of recurring instructor training I = Number of instructors LA = Average length of instructor assignment in years CL = Course length of instructor training course MW = Average cost per instructor man-week
Student Personnel Costs	SC = S x %PG x CL x MPC where: SC = Cost of military personnel in training S = Number of military personnel for high/low training scenarios %PC = Percentage distribution of personnel for training status (by pay grade) CL = Course length in weeks by method of instruction MPC = Weekly military personnel cost by rank

Table 3

Discounted Life Cycle Costs of the Computer-based Education (CBE) and Conventional Instruction (CI)

Present Year[a]	Life Cycle Cost		Discount Factor	Discounted Annual CI Cost ($)	Discounted Annual CBE Cost ($)	Present Value Differential Costs (CI - CBE) ($)
	CI System ($)	CBE System ($)				
0.	--	911,656	--	--	911,656	- 911,656
1.	8,294,347	523,516	.954	7,912,807	9,085,434	-1,172,627
2.	8,294,347	897,368	.867	7,191,199	714,018	- 522,819
3.	8,294,347	602,522	.788	6,535,945	990,787	+ 545,158
4.	8,294,347	7,085,256	.717	5,947,047	5,080,129	+ 866,918
5.	8,294,347	598,958	.652	5,407,914	302,521	+1,105,393
6.	8,294,347	6,018,789	.592	4,910,253	3,563,123	+1,347,130
7.	8,294,347	6,018,789	.538	4,462,359	3,238,108	+1,224,251
8.	8,294,347	6,018,789	.489	4,055,936	2,943,188	+1,112,748
9.	8,294,347	6,018,789	.445	3,690,984	2,678,361	+1,012,623
10.	8,294,347	6,018,789	.405	3,359,211	2,437,610	+ 921,601
Total	82,943,470	70,713,221		53,473,655	47,944,935	+5,528,720

[a]Economic life of CI and CBE systems--10 years.

Table 4

Nondiscounted Life Cycle Costs ($), FY79-89

Cost Category	FY79	FY80	FY81	FY82	FY83	FY84	FY85	FY86	FY87	FY88	FY89	Total
Computer-based Education (CBE)												
Research & Development												
Instructor Training	--	35,000	--	--	--	--	--	--	--	--	--	35,000
Time Management	--	--	25,000	25,000	--	--	--	--	--	--	--	50,000
Systems Evaluation	--	15,000	15,000	25,000	--	--	--	--	--	--	--	55,000
Systems Analysis	--	50,000	--	--	--	--	--	--	--	--	--	50,000
	--	100,000	40,000	50,000	--	--	--	--	--	--	--	190,000
Investment												
Hardware/Software	600,000	600,000	600,000	--	--	--	--	--	--	--	--	1,800,000
Initial Instructor Training	--	19,787	--	--	--	--	--	--	--	--	--	19,789
Instructional Development[a]	56,962	411,691	358,543	412,547	416,636	247,037	--	--	--	--	--	1,903,416
CMI Test Coding	--	--	25,648	25,648	25,648	25,648	--	--	--	--	--	102,592
	656,962	1,031,480	984,191	438,195	442,284	272,685	--	--	--	--	--	3,825,797
Operation & Support												
CBE Section[b]	254,694	260,794	342,494	342,494	342,494	342,494	342,494	342,494	342,494	342,494	342,494	3,597,934
Instructor Cost	--	1,410,144	1,321,216	1,232,288	1,143,360	1,067,136	1,029,024	1,029,024	1,029,024	1,029,024	1,029,024	11,319,264
Recurring Instructor Training	--	13,193	13,193	13,193	13,193	13,193	13,193	13,193	13,193	13,193	13,193	131,930
CBE Student Cost[c]	--	227,192	1,314,411	2,737,994	3,550,652	4,061,662	4,634,078	4,634,078	4,634,078	4,634,078	4,634,078	35,062,301
CI Student Cost[d]	--	6,480,713	4,881,863	2,788,358	1,593,273	841,788	0	0	0	0	0	16,585,995
	254,694	8,392,036	7,873,177	7,114,327	6,642,972	6,326,273	6,018,789	6,018,789	6,018,789	6,018,789	6,018,789	66,697,424
Life Cycle Cost ($)	911,656	9,523,516	8,897,368	7,602,522	7,085,256	6,598,958	6,018,789	6,018,789	6,018,789	6,018,789	6,018,789	70,713,221
Conventional Instruction (CI)[e]												
Operation & Support												
Instructor Costs	--	1,460,960	1,460,960	1,460,960	1,460,960	1,460,960	1,460,960	1,460,960	1,460,960	1,460,960	1,460,960	14,609,600
Recurring Instructor	--	--	--	--	--	--	--	--	--	--	--	--
Training	--	18,568	18,568	18,568	18,568	18,568	18,568	18,568	15,568	15,658	15,658	185,680
Student Costs	--	6,814,819	6,814,819	6,814,819	6,814,819	6,814,819	6,814,819	6,814,819	6,814,819	6,814,819	6,814,819	68,148,190
	--	8,294,347	8,294,347	8,294,347	8,294,347	8,294,347	8,294,347	8,294,347	8,294,347	8,294,347	8,294,347	82,943,470

[a] Moderate man-hour conversion factor.

[b] Includes military and civilian personnel services, computer maintenance, and other miscellaneous costs (e.g., supplies, telephones, etc.).

[c] Based on CBE course length reduction of 32 percent applied to CI course length, assuming a high student flow scenario.

[d] During CBE system implementation, FY79-84, student personnel costs will be incurred for both CI and CBE up to the point that CBE is fully on-line in each course; therefore, cost comparisons of the two methods of instruction requires that students costs be accounted for both CI and CBE.

[e] No research and development or investment costs were identified under CI method of instruction.

A measure of payoff was developed to compare the cost avoidance associated with reduced training time on a course-by-course basis. This measure is a ratio of differential student costs (CI student costs minus CBE student costs, where CBE student costs equal CBE student personnel costs plus the CI cost share incurred during system conversion) to courseware development costs. These ratios used to aid in selecting courses for implementation are displayed in Table 5. In general, these ratios would change given a different implementation period.

Table 5

Differential Student Costs to Instructional Development Cost Ratios by Course, FY's 1980-89

Course	Differential Student[a] Cost, FY's 1980-89	Course Development[b] Cost, FY's 1980-89	Cost Ratio
CCMC	$2,993,592	$313,292	9.6
FDLC	1,191,213	67,839	17.6
BEC	5,459,734	412,653	12.9
FROC	3,818,804	264,302	14.4
RFC	881,575	218,136	4.0
GRRC	2,154,976	686,213	3.1

[a]Based on high student flow and CBE course length reduction of 32 percent.

[b]Based on moderate man-hour conversion factors, assuming military developers.

Additional supporting information used to derive life cycle costs and conduct the study is presented in Appendix C. Types of information provided in Appendix C include: (1) CBE conversion hours for courses, course implementation sequence, detailed yearly student costs for low and high scenarios, (2) estimated costs for the extant CBE section at MCCES, (3) course development materials costs, and (4) student costs incurred during conversion to CBE.

Other Cost Considerations

A number of cost considerations are mentioned, although detailed review of them is beyond the scope of this analysis. These factors are briefly discussed to provide information that Marine Corps personnel should consider in developing the CBE system.

1. Instructor manning under CBE will be less than staffing requirements for lecture instruction. What is sometimes overlooked, however, is that instructor reductions are offset by new requirements for computer

support personnel. A manpower staffing study is needed to determine actual CBE instructor and computer support personnel requirements. This study should be conducted after the computer system has been selected in order to make more accurate manpower estimates. If self-paced instruction without computer support was used instead of CBE, the number of instructors required would probably be no less than is needed for group lecture instruction given current MCCES manning. In fact, individualized instruction, on the proposed scale, if it were not supported by computer capabilities, could possibly require more personnel to handle the added duties associated with individualized study and management. A manually managed individualized self-paced system would not require an investment in ADP equipment/software nor outlays for its operation and maintenance, although other equipments (e.g., optical mark readers) might be required. In addition, a significant increase in administrative support personnel would be required to develop manually the 1700-plus individualized learning prescriptions, including the accounting and allocation of training resources to maximize learning efficiency with minimum queing delays.

2. Instructor training must be conducted regardless of whether the instruction is provided by lecture or by CBE; instructor training costs will be increased, however, during the period that the CBE system is being installed because dual training will be required. That is, during the conversion period, training will be required for both lecture and CBE instructors.

3. Although student personnel costs are expected to decrease with CBE, this reduction will occur only if full CBE capabilities are developed and used. Particular attention needs to be directed toward ensuring that students completing a CBE course go directly into another course or to their job assignment. To the extent that students remain in a waiting status, student costs will increase with no obtained benefit. Detailed estimated student costs for the CBE system are presented in Appendix C.

4. Instructional materials development costs are high for any form of individualized instruction. Costs for developing materials for a CMI, especially for CAI systems, are even higher because of the need to code the materials onto the computer. Table 6 presents the estimated total materials development costs for the CBE system, divided into authoring and coding categories. For comparison, these costs for a noncomputer-based individualized system, which needs only materials authoring, are also included.

5. To resolve the question of the relative contribution of the computer to reducing individualized instruction training time, attention should be directed toward comparing the effects of a CMI/CAI course managed both with and without a computer. This comparison would provide significant information regarding the relative rates of course completion through a course that is operated both with and without computer support. This information could be used to modify future implementation plans as required. During this comparison, all efforts should be made to determine not only the costs of system operation but also the benefits provided to management and, of course, to the student.

Table 6

Instructional Development Costs

Task	CBE ($K)	Individualized ($K)
Authoring	1490	1490
Coding	413	0
Total	1903	1490

In the following section, two cost sensitivity analyses are presented. These analyses examine the effects on the system caused by varying the percent reduction in CBE course completion times, student entries, and estimates of the necessary time to develop CBE instructional materials.

COST SENSITIVITY ANALYSES

Sensitivity analyses were performed to examine the variation of life cycle costs (LCC) estimates resulting from changes in the assumed values of CBE course length reductions, annual student flow conditions, and CBE man-hour conversion factors. As previously noted, contingency assumptions were formulated to assess the cost effectiveness of CBE if values for these three variables vary.

These analyses suggest that CBE system cost effectiveness is insensitive to contingency values presented above and assumes military developers. The greatest degree of cost uncertainty involves estimates of CAI and CMI instructional development times and costs. Increases in actual CAI/CMI development times could lengthen the period of implementation and result in higher student costs, as well as higher instructional development costs. Conversely, decreased CAI/CMI development time would result in earlier implementation and lower student and development costs. If the implementation period was prolonged by more than 2 years, the CBE system could become more costly than CI. For this reason, MCCES should continually monitor actual man-hours expended to write and code lesson materials.

Nondiscounted LCC estimates based on the economic analysis, including the sensitivity analyses, are summarized in Table 7. Separate comparisons are made for high and low student flow scenarios since the number of student entries is independent of the method of instruction. Estimates for CI vary only as a function of student entries. CBE estimates vary as a function of student entries, course length reductions, and CBE instructional development times. The latter are based on military instructional developers.

Table 7

LCC Comparisons by Student
Flow and Method of Instruction
(In Millions of Dollars)

	High Student Flow		Low Student Flow	
Outcome	CBE	CI	CBE	CI
Optimistic	63.9	82.9	57.8	73.9
Most Likely	70.7	82.9	63.8	73.9
Pessimistic	77.9	82.9	70.2	73.9

Several observations concerning this table are in order. First, a high student entry scenario is expected to prevail over the 10-year period. Thus, more confidence should be placed on LCC estimates based on the high flow case. Second, CBE costs could increase to the extent that CBE instructional materials are developed under contract. The "best estimate" of

contract cost is nearly $3.4 million, which covers instructional materials development for all six courses. In the event of low personnel requirements, and an average course length reduction of 20 percent under CBE, there is a low risk that CBE and CI would cost about the same, assuming that all instructional materials were developed under contract.

Reductions in Training Time

It is generally recognized that computer-based training, with its self-paced elements, results in significantly less student training time than conventional lecture instruction. Actual reductions in training time have varied from 12 to 89 percent. When analyzing a proposed CBE system, it is necessary to select a percent figure for computing student training costs. Although estimates vary widely, MCCES selected a 35 percent reduction in their economic analysis supporting the CBE system acquisition. A slightly more conservative figure of 32 percent was chosen for the present analysis. This figure was the average training time reduction found in Orlansky and String's[7] comparison of several CAI/CMI studies (1979).

A cost sensitivity analysis was performed to determine how student costs would be affected by higher or lower percentage reduction in course length under CBE. Forty-four percent as a high estimate was selected because that was the median percent savings reported by Orlansky and String when they examined direct CMI and lecture instruction comparisons. Twenty percent was chosen as the low estimate since it was equally distant from 32 percent, but in a conservative direction. These reductions, expressed as a percent of CI course length, translate into CBE training times of 80 percent, 68 percent, and 56 percent.

The sensitivity of CBE and CI student costs was also investigated based on variable student entry conditions of either 4997 or 4180 trainees per year. Reductions in training time have a considerable effect on personnel costs, and this effect increases (decreases) as more (fewer) students undergo training. Table 8 illustrates how student costs vary as a function of different training times and student entry levels.

The cost avoidance associated with the individualized nature of CBE would increase substantially in the event of a full mobilization of the Marine Corps and concomitant rise in training loads. It is unlikely, however, that the improved training efficiency could be sustained under individualized instruction without computer management. Under conditions of relatively high student input, there would be a normal cadre of CBE system instructors. The question remains as to how the system would adjust to a surge in daily student loads from approximately 1700-1900 students to as many as 5000 students daily. The answer requires increasing the number of (1) students in a learning center, (2) operating learning centers, and (3) shifts that are operated each day. In the Navy CMI system, this ability to adjust to varying loads has been demonstrated during a period of high student input when one of the Basic Electricity and Electronics Schools operated three full 6-hour shifts per day.

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[7] See footnote 5.

Table 8

Cost Sensitivity Analysis: Variable Student Flow Scenarios
by Method of Instruction and CBE Course Length Reduction

Total	Student Flow	CI Student Personnel Costs ($), FY80-89	CI Student Personnel Cost Share ($), FY80-84[a]	CBE Student Personnel Cost ($), FY80-89 (Variable Course Length Factors)		
				80%	68%	56%
CCMC	High	10,023,190	668,213	7,483,980	6,361,385	5,238,791
	Low	9,373,620	624,908	6,998,973	5,949,123	4,899,281
FDLC	High	4,136,170	413,617	2,978,046	2,531,340	2,084,634
	Low	3,963,630	396,363	2,853,810	2,425,743	1,997,667
EEC	High	20,680,810	3,619,142	13,649,336	11,601,934	9,554,531
	Low	19,818,150	3,468,176	13,079,979	11,117,981	9,155,983
FROC	High	16,273,320	4,339,552	9,547,017	8,114,964	6,682,911
	Low	10,929,880	2,914,635	6,412,193	5,450,368	4,488,535
RFC	High	4,407,880	1,652,955	2,203,938	1,873,350	1,542,756
	Low	3,661,950	1,373,231	1,830,975	1,556,331	1,281,681
GRRC	High	12,626,820	5,892,516	5,387,445	4,579,328	3,771,211
	Low	11,363,560	5,302,995	4,848,453	4,121,184	3,393,915
Total	High	68,148,190	16,585,995	41,249,762	35,062,301	28,874,834
	Low	59,110,790	14,080,308	36,024,383	30,620,730	25,217,062

[a]Student personnel costs incurred during CBE implementation FY80-84. These costs represent the CI student cost share and must be added to CBE student costs to avoid underestimating total student costs incurred during the conversion from CI to CBE.

Time to Develop Instructional Materials

The amount of effort necessary to develop individualized materials for computer-based training is enormous. It is only through expenditure of this effort, though, that the benefits of individualized instruction can be obtained. Because of the large amount of time and money needed for development, this time factor must be monitored closely. In the early years of CAI, some estimates of the amount of time necessary to develop 1 hour of instructional material were as high as 600-700 hours. As CAI technology and the ISD process have developed, the estimates and the actual times have dropped considerably. CBE instructional development and coding times are, however, still subject to a great deal of variability, and so the costs can vary considerably.

For the recommended CBE system, a moderate time for instructional material authoring was selected--100 hours per hour of instruction. The time required for coding the instructional and test material onto the system was estimated at 20 hours per CMI hour, and 50 hours per CAI hour of instruction. For the sensitivity analysis, higher and lower figures were developed. These figures, presented previously in Table 1, were chosen because they represent realistic estimates of what could occur if instructional development time is not closely monitored.

Authoring, moderately estimated at 100 hours per instructional hour, includes those activities necessary to conduct a brief analysis of existing training materials, development of training objectives and measurement standards, preparation of lesson and test materials, and the graphic support work to produce illustrated material. An extensive requirement for multiple media formats is not included in these estimates. Coding time, moderately estimated at 20 to 50 hours per CMI or CAI hour, includes these activities required to properly code developed instructional materials into the CMI or CAI system. These estimates were applied to both military and civilian developers. The lower conversion values represent optimal times (costs) for contractor personnel with broad experience in CAI/CMI instructional materials development. The high conversion factors represent figures consistent with some actual materials development experiences. The moderate value represents the "best guess" of current development organizations.

Results of the instructional man-year requirements cost sensitivity analyses are displayed in Table 9. Instructional development costs comprise the largest outlay in CBE development. The amount of time expended to develop instructional materials and implement the CBE system requires careful monitoring, since optimal training efficiency depends on timely implementation. Prolonged implementation will vitiate student cost reductions associated with CBE.

Even though it would be less costly to use military personnel for instructional material development, the material developed by the civilian professional developer would surely be better. Better instructional material would result in better student achievement, perhaps even less training time. Excellent instructional materials in the Marine Corps schools might indirectly improve recruitment incentive if trainees report favorably to their friends about the training experience. Admittedly, there is no objective evidence to support this projected benefit.

Table 9

Cost Sensitivity Analysis: Man-year Conversion Factors by Course and Type of Man-year

Course	Military			Contract		
	Low	Moderate	High	Low	Moderate	High
	CBE Man-year Course Development Requirements (Man-years)					
CCMC	17.13	24.43	36.64	15.16	21.62	32.43
FDLC	3.68	5.29	7.94	3.25	4.68	7.03
BEC	19.10	27.59	41.38	16.90	24.42	29.70
FROC	14.42	20.61	30.89	12.76	18.23	27.34
RFC	11.79	17.01	29.51	10.44	15.05	26.12
GRRC	37.15	53.51	80.27	32.87	47.36	71.03
Total	103.27	148.44	226.63	91.38	131.36	193.65
	CBE Man-year Course Development Costs ($)					
CCMC	217,619	310,359	465,475	586,500	810,750	1,216,125
FDLC	46,751	67,204	100,870	121,875	175,500	263,625
BEC	242,646	350,503	525,691	633,750	915,750	1,113,750
FROC	183,192	261,829	392,427	478,500	683,625	1,025,250
RFC	149,780	216,095	374,895	391,500	564,375	979,500
GRRC	471,954	679,792	1,019,750	1,232,625	1,776,000	2,663,625
Total	1,311,942	1,885,782	2,879,108	3,426,750	4,926,000	7,261,875

Notes.

1. Different man-hour conversion factors for CMI and CAI were applied to course hours as follows: CMI conversion factors used for all performance-related POI hours and 50 percent of knowledge-related POI hours; CAI conversion factors were applied to remaining knowledge-related POI hours. Direct military man-hours in a man-year estimated at 1693.

2. Low man-hour conversion factors for CMI and CAI were specified as follows: CMI--75 man-hours for authoring and 10 man-hours for coding; CAI--75 man-hours for authoring and 25 man-hours for coding.

3. Medium man-hour conversion factors for CMI and CAI were specified as follows: CMI--100 man-hours for authoring and 20 man-hours for coding; CAI—100 man-hours for authoring and 50 man-hours for coding.

4. High man-hour conversion factors for CMI and CAI were specified as follows: CMI—150 man-hours for authoring and 30 man-hours for coding; CAI—150 man-hours for authoring and 75 man-hours for coding.

5. Military man-years were estimated at $12,704 (E-6) while contract man-years were estimated at $37,500.

Since costs are so high for civilian development, an alternative would be to have civilians develop the first two courses, one a maintenance course (FDLC) and the other, an equipment operating course (CCMC). Those course materials could then serve as models for military instructional developers working on subsequent courses. This approach would require, using the moderate conversion rates for development, approximately $175K and $811K for FDLC and CCMC respectively.

RESEARCH AND DEVELOPMENT RECOMMENDATIONS

The research and development recommendations presented in this section include both those developmental efforts that are necessary for successful CBE system design and development, and the research efforts that will serve to make the MCCES system fully functional and place it at the forefront of large-scale, operational, computer-based training. If developed according to the recommended implementation plan, the MCCES system will offer the Marine Corps the opportunity for a training system that goes beyond the capabilities of any existing computer-based system. Such a system would not only be able to manage and monitor the progress of individual students through individual technical courses, but also through a sequence of courses. Additionally, the system would be able to relate training achievement to actual job performance through an external evaluation system, and to provide total internal evaluation of instructional materials and system cost effectiveness.

Research Efforts

To realize the full potential of this planned CBE system, the four recommended research efforts discussed in the following pages must be accomplished. The first two projects--system analyses and CMI instructor training--are necessary for successful initial system design and implementation; and the second two--time management and system evaluation--for developing the full system capability. Each of these efforts will be described separately.

System Analysis

Although this effort is included in the R&D section, it is a vital component of the implementation plan and must be accomplished to achieve a working CBE system. The purpose of this work is to conduct the system analysis tasks that will provide the general framework and the detailed computer software for the entire CBE system. This framework will give organizational structure to the computer processes that are required to satisfy all the functional requirements. In general, this involves conducting the analysis required to lay out and document the computer processes and file structures that will enable the system to provide the desired instructional, managerial, and evaluation capabilities when fully implemented.

This task is absolutely vital to system success and must be accomplished by a highly trained systems analyst, ideally, one experienced with large-scale military CMI systems. This expertise does not presently exist within MCCES personnel resources. To obtain the level of product necessary, a contracted or consultant effort would probably be required to accomplish this work. Suitable contractors or consulting systems analysts (CSA) should have extensive computer systems analysis experience, familiarity with computer-based training, and intimate experience with large scale military technical training.

The CSA would be charged with developing the total CBE system design and would work with the analysts provided by the vendor and the MCCES to assure compatibility of functional system requirements with machine

processing capabilities. The CSA should work from the CBE office and report to the military CBE project officer. Systems analyst personnel now existing and planned for the CBE office should be able to provide sufficient support to the CSA to accomplish actual system programming.

The CSA should be working at this time. Ten to twelve months of effort are probably required and it is estimated that this will cost approximately $50,000 during FY 1980. Detailed information regarding the actual tasks to be accomplished by the CSA are provided in the implementation plan under Functional Objectives 2.0 (Design CBE System) and 3.0 (Develop Computer Software Programs).

CMI Instructor Training

The second effort that must be accomplished to ensure successful initial system implementation is the development of a CMI instructor training package. Current training of lecture instructors is not adequate for personnel assuming the CMI instructor job. This research requires specifying the proper instructor job functions, developing the training materials for Marine Corps personnel assigned the CMI instructor billet, and evaluating/revising these materials.

A project that will provide the CMI instructor role definition and job specification for the MCCES system has already been planned and is now getting underway. The planned CMI instructor training research is to be performed by the McDonnell Douglas Corporation and is jointly funded by NAVPERSRANDCEN and the Advanced Research Projects Agency (ARPA). Joint funding is occurring since this project meets the needs of the Navy, Air Force, and proposed Marine Corps computer-based training systems. The general CMI instructor role model and the MCCES CMI instructor job specification are expected from McDonnell Douglas during January 1980, if the present contract schedule is maintained.

The instructor training research that would be needed during the January-August 1980 timeframe, and has not been scheduled, includes the development and test of the actual instructor training package for Marine Corps CMI instructors. It is estimated that actual instructor training would require about 1 full week. Development of the materials by a contractor, together with test and revision of the materials, is estimated to cost approximately $35,000 during FY 1980.

It should be noted that the planned McDonnell Douglas contract will only provide the Marine Corps CMI instructor job specification and not the developed training materials. The research recommended in this report will provide for the training materials and necessary evaluation, if the additional funding can be secured.

Time Management

Although the CBE system computer will have the capability for predicting student completion times and tracking study completion times, research is needed to make sure that the predictions are accurate and that proper time

management procedures are used in the learning centers. These procedures keep training time to a minimum and are a major determinant of the high degree of cost avoidance associated with a successful CBE system. Procedures developed and used on the Air Force CMI system have been shown to succeed in reducing required training time. These procedures could be redesigned to fit the requirements of the Marine Corps and their effectiveness tested on the CBE system. A contractor could perform this research, which is estimated to cost approximately $50,000 over 12 months. Ideally, this work would be performed during FY 1981 and FY 1982, with $25,000 allocated each fiscal year.

System Evaluation

The final research recommendation necessary to ensure full system capability involves developing the system evaluation feature of the CBE system. Evaluation within the CBE context should include: student achievement evaluation, instructional materials evaluation, instructor evaluation, CBE program evaluation, and training evaluation in terms of an external measure of job performance. Planned characteristics of the system will provide the student, materials, and instructor evaluation capabilities. The necessary additional research will focus on developing the system's ability to evaluate itself in terms of system cost-effectiveness and job performance. This work could be performed by a contractor, and is roughly estimated at a cost of $15,000 for FY 1980, $15,000 for FY 1981, $25,000 for FY 1982. Although this work is not necessary for initial implementation, the research is required if the CBE system is to attain its full capabilities.

Other CBE Research

Other research activities that may play a part in the development of the CBE system are mentioned below. Two of these efforts involve contributions by reserve Marine Corps officers.

Student Proctors. Dr. Dick Evans (COL, USMCR) will be developing and testing a model for the presentation of individualized instruction during the summer of 1979. NAVPERSRANDCEN has provided the IBM 5110 computer necessary for the conduct of this study. This study will examine procedural changes which can facilitate self-paced study under competency-based instruction using student proctors to aid the instructor. Information from this effort will be used to develop general procedures for guiding students under computer management in the individualized instruction setting. NAVPERSRANDCEN may soon have complementary research underway in the area of student proctor use in the Navy CMI system. The results could easily apply to the Marine Corps' setting.

System Acceptance. Dr. Lanny Kope (LTCOL, USMCR) will be developing documents to describe the CBE system to the school user community and the educational world at large. This documentation should help gain MCCES training staff acceptance and provide information to organizations external to MCCES.

Full Mobilization Capability. As presently envisioned, the MCCES CBE system will be implemented with a student load of 1500-2000. In the event of a national emergency requiring full mobilization, this system load could increase to approximately 5,000. Prudence would appear to dictate that a research effort be undertaken soon to determine the exact augmentations necessary to enable the CBE system to meet this surge in an orderly and effective manner. Estimates of the required increments in personnel and logistical support, together with procedural guidelines for securing these in a timely manner, can be arrived at by simulation and should be documented for easy access by command personnel. It is estimated that a complete product of this kind could be supplied as early as 1983, or 1 year after the system becomes operational to an extent sufficient to provide an accurate basis for simulation.

In conclusion, the instructional materials development effort is not included in this section as research; rather, it is presented in the implementation plan since it is an absolute requirement for system implementation. The decision concerning the strategy to be followed in developing instructional materials is recognized to be partly economic, but it must be pointed out that abundant empirical evidence already exists to support the contention that false economies at this critical stage can be devastating to the eventual success of the system. Contractual development of instructional materials, by professional developers, is considered vital to initial system success. If the first two courses were professionally developed, they could then serve as models for development of other materials by MCCES personnel.

Long-range CBE Requirements

The implementation plan described in this report will assist MCCES through the next 4 to 5 years in developing the CBE system. This recommended implementation includes the development of six courses for CAI and the remaining 40+ courses for computer management, while they remain lecture courses. Long-range CBE considerations should include the instructional development of those 40+ courses for possible implementation onto the CAI system. It would not be surprising during the next years if courses taught at MCCES were changed and these changes might alter the course implementation schedule. Certainly, the CBE office and MCCES Command should be flexible when deciding precisely which courses to install. The needs of the Fleet Marine Force and the training community, as well as cost effectiveness, should be the driving forces in selecting courses for implementation.

As the current CBE system matures, two pressures may be exerted on MCCES Command. The first of these pressures involves the need to provide documentation of the CBE system to other Marine Corps training commands that would want to acquire a similar system. Accordingly, MCCES should develop a documents file so that other commands can benefit directly from the MCCES experience. Clearly, Headquarters Marine Corps should be kept informed of CBE developments at MCCES so that they can make informed decisions about whether the CBE system should be acquired and installed at other Marine training sites. To provide Marine Corps Headquarters with the best information requires full development of the evaluation capability of the system, so that higher management levels can see the extent of cost effectiveness associated with CBE.

The second pressure on MCCES may come from within and would take the form of numerous requests for adding more courses onto the present system. Although the course implementation schedule could be adjusted, it may not be possible to add many more courses onto the system with its current computer configuration. Therefore, future consideration may have to be given to altering the computer configuration in order to adjust to future training requirements. Additionally, the costs and capability of computer technology are changing so rapidly that in only 2 or 3 years new devices of much lower costs may be available that would significantly improve computer operation. It is not possible to predict either the practical options that will be available for computers or the exact specifications for additional computer-based training requirements within MCCES or in other commands.

The extent of additional requirements for computer-based training will depend upon the success of the system recommended by this report. The MCCES CBE system has the potential for developing into the world's finest large-scale operational training system that is managed via computer.

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APPENDIX A

IMPLEMENTATION PLAN TASK STATEMENTS

Notes:

1. The numerical priority rankings appearing in the task statements are defined as follows:

- 1 = Completion of task required for initial system implementation.
- 2 = Completion of task required for full system capability.
- 3 = Completion of task required for full system implementation.

2. The alphabetical codes used to indicate required level of expertise on the task statements are defined as follows:

- A = Can be accomplished by MCCES personnel presently available within currently authorized assets.
- B = Can be accomplished by MCCES personnel but would require augmentation of the MCCES T/O.
- C = Can be accomplished by MCCES personnel with the assistance of outside professional consultants.
- D = Can best be accomplished by a professional contractor.

FUNCTIONAL OBJECTIVE: 1.0 Enlist the Participation of Training Personnel

ENABLING TASK NO.: 1.0 PRIORITY: 1

TASK STATEMENT: Obtain participation of training personnel to ensure system acceptance through proper development of system requirements, instructional materials, and system functioning.

BEGIN: Already Underway COMPLETE: Through life of system.

PERFORMING ORGANIZATION ELEMENT: Personnel from management and course levels of training establishment.

REQUIRED EXPERTISE: Level A: Whatever they presently possess.

Failure to enlist the support of the training personnel from the beginning will ensure failure of the CBE system. In order to ensure acceptance of the CBE system, it is vital to make sure that the training personnel who will be using the system have opportunities to provide information about their training requirements, their perceptions of the systems capabilities, and the adequacy of the materials and the system operation. This participation must be a continuing activity, not only through system development, but also throughout system operation. It is only through training personnel learning about the system's capabilities that CBE will be recognized for the important learning vehicle that it is.

ENABLING TASK NO.: 1.1 PRIORITY: 1

TASK STATEMENT: Provide feedback to CBE office regarding perceptions of the adequacy of the proposed CBE system.

BEGIN: August 1979 COMPLETE: August 1979

PERFORMING ORGANIZATION ELEMENT: Training personnel from the command and course level.

REQUIRED EXPERTISE: Level A

This feedback must be solicited by the CBE office and should seek not only evaluative remarks but also suggestions for changes and criticisms. In presentation of the proposed CBE system, CBE staff should actively encourage participation by course and command level training personnel in whatever capacity is possible. At the very least, written feedback should be provided to make sure that comments are retained by the CBE staff.

ENABLING TASK NO.: 1.2 (sequenced for each course to be developed as 1.2.1----1.2.6) PRIORITY: 1

TASK STATEMENT: Training course personnel provide input into the course analysis portion of instructional development to ensure that any needed changes in training objectives will be incorporated into the new course.

BEGIN: CCMC-August 1979 and whenever each course begins instructional development. COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Course training personnel.

REQUIRED EXPERTISE: Level A

Instructional developers should have a data form available for course personnel to complete. This form should direct course personnel to review their training objectives and to identify any objectives requiring change. Instructional developers should then review these identified objectives with the staff members to obtain a detailed description of the required objective and appropriate measurement standards. There may be objectives that are obsolete and would drop out of the POI. These should be identified and deleted.

ENABLING TASK NO.: 1.3 (Sequenced through each) PRIORITY: 1
course to be developed as task
1.3.1-----1.3.6)

TASK STATEMENT: Provide information and students to assist in validation of individualized instructional materials.

BEGIN: During materials development phase.

COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Training course personnel, and 6-10 students from current course or awaiting instruction.

REQUIRED EXPERTISE: Level A: Students should not have experienced training in the area to be validated.

Course managers should provide information as to perceptions about the adequacy of the new instructional materials. Developers should make sure that comments are recorded and appropriate changes included into subsequent materials. The students should be used to validate the materials by proceeding through small sections of instruction, from approximately one hour to a day or two. Care should be taken to obtain a measure of the student's completion time for each module to assist in development of student management functions by the CBE office staff.

ENABLING TASK NO.: 1.4 PRIORITY: 1

TASK STATEMENT: Training personnel, from courses to be implemented into the CMI system only, should provide course and testing information necessary for putting testing capabilities into the computer.

BEGIN: After October 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Course personnel

REQUIRED EXPERTISE: Level A

Course personnel should provide copies of POI and estimated class schedules, training objectives, and tests that are to be automatically scored to the CMI instructional developers. Assistance will probably be needed by the developers to alter existing test-items to make them suitable for CMI implementation. Developers should make sure that they teach the course personnel what the CMI system will do for training personnel. This task should be as instructive for the course personnel as it is for the developers.

ENABLING TASK NO.: 1.5 PRIORITY: 1

TASK STATEMENT: CCMC training personnel should provide reactions to the CBE system implementation of their course after its initial tryout on the CAI/CMI system.

BEGIN: August 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CCMC training personnel

REQUIRED EXPERTISE: Level A

This task should be an opportunity for the CCMC personnel to register criticism about the system. Every effort should be taken to get the course staff involved in making the CBE system work. True system success will occur only after the course personnel accept the system as theirs. Particular attention should be paid to altering management practices that are burdensome on the training staff.

ENABLING TASK NO.: 1.6 PRIORITY: 3

TASK STATEMENT: Training personnel for each course on the system should provide input to the system regarding the system's effectiveness in carrying out its training responsibility.

BEGIN: Semi-annually COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Course Personnel

REQUIRED EXPERTISE: Level A

Personnel from courses on either the CAI or the CMI systems should provide information to the CBE system about its apparent effectiveness. The computer system itself will provide summary information to the CBE office and ultimately to MCCES management, but course personnel should be able to formally indicate to the CBE office their level of satisfaction with the system and their suggestions for its improvement.

FUNCTIONAL OBJECTIVE: Design the CBE System

ENABLING TASK NO.: 2.0

This objective is central to the successful completion of the entire project. We have chosen to present the system design plan in two separate sections, one dealing with design of the instructional system and one dealing with design of the computer system which will support it.

Instructional System. The design of any instructional system should proceed in the light of careful analyses of who is to be taught to do what and how well. From such analyses, there emerges an instructional technology that may best be described as a system of interacting components. This is the case with the instructional mission of MCCES, and the first section of this system design plan is devoted to an implementation plan for specifying in considerable detail the design characteristics of the optimal system for meeting the instructional requirements of the MCCES CBE system.

Computer System. In light of the requirements for the instructional system set forth in the design of that system, a computer system as a major support element can be designed. A plan for implementing this design is presented in the second section of this system design plan.

It is important that these two systems be kept conceptually distinct, at least initially. The computer should always be viewed as a device to aid and support the instructional process, not as a constraint which dictates solutions to problems of instructional design or procedure. By keeping the computer system properly subservient at the design stage, there is a greater liklihood that the eventually combined system will serve the need for which it is intended: to provide maximally effective training at the lowest possible cost for USMC personnel.

Two major recommendations emerge from consideration of the system design plan:

(1) A highly qualified systems analyst must be retained as soon as possible and be made responsible for design and implementation activities throughout the developmental life of the project.

(2) The entire computer system must be planned and designed as a unit, not as a series of sequential systems to be appended as they are developed.

The rationale for each of these recommendations is discussed in detail on the relevant task sheet.

FUNCTIONAL OBJECTIVE: Design Instructional System

ENABLING TASK NO.: 2.1 PRIORITY: 1

TASK STATEMENT: Design the instructional system.

BEGIN: July 1979 COMPLETE: November 1979

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Level D: A highly qualified, experienced consulting systems analyst (CSA) with prior involvement in large scale, computer-based instructional technology.

The CBE staff of MCCES has made an excellent beginning on this overall task by putting in place a set of procedures for determining user requirements of the proposed system. It is well known that teachers are often resistant to change and innovation, but the effects of this resistance can be greatly lessened if a sense of participation and responsibility is inculcated from the outset. We believe an excellent beginning has been made for insuring this outcome and that the resulting system will benefit greatly.

Before the project proceeds much further, we regard as absolutely crucial the appointment of an experienced consulting system analyst (CSA) as described above. Designing a complex, computer-based instructional system to serve a multiplicity of courses and a variety of support and administrative functions is a task that will probably never be accomplished to perfection. There are always problems with particular subsystems getting or storing the data needed to perform its function without disrupting the operation of other subsystems and there is a continuing need to improve the interface of the entire system to meet the needs of the human clientele it serves. Given that it is impossible to design the perfect system, the next best thing is to avoid the crude and costly errors that have plagued earlier efforts. The surest way to accomplish this is to arrange for extensive and responsible involvement by an individual who is thoroughly familiar with the large, extant systems, preferably someone who was involved in the design and management of one or more of those systems.

21 (Continued)

We give the highest priority on securing the services of such an individual. Too much thought, effort, and dedication has already been expended on behalf of this venture to allow it to flounder because of a lack of experienced design support. Yet flounder it will if the critical stages of design and implementation are not discharged by someone with the highest level of skill and experience.

ENABLING TASK NO.: 2.1.1 PRIORITY: 1

TASK STATEMENT: Identify and contact services of outside Consulting Systems Analyst (CSA)

BEGIN: Immediately COMPLETE: ASAP

PERFORMING ORGANIZATION ELEMENT: MCCES Command and CBE Staff

REQUIRED EXPERTISE: Level A: Ability to evaluate credentials and experience of applicants. Level C.

ESTIMATED MAN YEARS: 1 Man-Year ESTIMATED COST: $50K for contract services.

ENABLING TASK NO.: 2.1.2 PRIORITY: 1

TASK STATEMENT: Develop preliminary specification of instructional procedures and design of supportability system.

BEGIN: August 1979 COMPLETE: August 1979

PERFORMING ORGANIZATION ELEMENT: CBE staff and CSA

REQUIRED EXPERTISE: Level C: Knowledge and experience with complex, individualized instructional systems.

It is recognized that a good portion of this task has been completed or is in progress. It therefore serves as an excellent entry point for the CSA to begin acquiring thorough familiarization with the existing instructional system and with the expectations of the users of the forthcoming system. At this stage, all proposed course delivery formats, testing procedures, record keeping functions, and necessary managerial operations should be identified and preliminary system descriptions completed.

ENABLING TASK NO.: 2.1.3 PRIORITY: 2

TASK STATEMENT: Present preliminary instructional system design to MCCES command personnel.

BEGIN: August 1979 COMPLETE: Same day

PERFORMING ORGANIZATION ELEMENT: CBE Staff and CSA

REQUIRED EXPERTISE: Level C

This step will insure that the proposed system meets the expectations of command personnel. Command personnel, in turn, can provide suggestions and guidelines in a timely manner, and thereby avert costly design errors arising from misinformation or erroneous assumptions.

ENABLING TASK NO.: 2.1.4 PRIORITY: 1

TASK STATEMENT: Present proposed instructional system to potential users: instructional staff, training managers, etc.

BEGIN: September 1979 COMPLETE: September 1979

PERFORMING ORGANIZATION ELEMENT: CBE staff and CSA

REQUIRED EXPERTISE: Level C

This step is one of the more crucial to the long range success of the system, since it must establish among the operational community the attitude that the system will belong to them, and that their input can be instrumental not only in its original design, but in later modifications.

An immediate product of this step will be the elicited feedback from the potential users, which will enter into the final design of the instructional system.

It is therefore critical that enough time be taken to complete this step thoroughly so that design can proceed on the basis of the best information currently available.

ENABLING TASK NO.: 2.1.5 PRIORITY: 1

TASK STATEMENT: Incorporate user feedback in revision of system design.

BEGIN: September 1979 COMPLETE: September 1979

PERFORMING ORGANIZATION ELEMENT: CBE Staff and CSA

REQUIRED EXPERTISE: Level C

See 2.1.4. Designers must evaluate user feedback and redesign the system in accordance with relevant comments and suggestions.

FUNCTIONAL OBJECTIVE:

ENABLING TASK NO.: 2.1.6 PRIORITY: 1

TASK STATEMENT: Formalize instructional system by preparing a document describing the precise instructional features of the system.

BEGIN: September 1979 COMPLETE: September 1979

PERFORMING ORGANIZATION ELEMENT: CSA and CBE staff

REQUIRED EXPERTISE: Level C

This step will yield a product that is a formal description of the entire instructional system as envisaged. It will include not only the detailed presentation of the methods and procedures to be used in the six courses intended for conversion to CAI/CMI delivery, but will specify those procedures, such as automated test scoring and student management, that will be added to courses designed for CMI implementation only.

ENABLING TASK NO.: 2.1.7 PRIORITY: 1

TASK STATEMENT: Define and document the computer capabilities required to support the instructional system.

BEGIN: October 1979 COMPLETE: October 1979

PERFORMING ORGANIZATION ELEMENT: CSA and CBE staff

REQUIRED EXPERTISE: Level C

This step is necessary to make explicit the computer system requirements and capabilities necessary to bring the instructional system formalized in 2.1.6 into existence. Only by formalizing this step can we be assured that the proposed system has the capability of doing exactly what is expected by the users and designers.

ENABLING TASK NO.: 2.1.8 PRIORITY: 1

TASK STATEMENT: Finalize instructional system design by documenting instructional attributes of CBE system.

BEGIN: November 1979 COMPLETE: December 1979

PERFORMING ORGANIZATION ELEMENT: CSA and CBE staff

REQUIRED EXPERTISE: Level C

This step integrates the products of 2.1.6 and 2.1.7 and yields a final document that will serve as the basic reference throughout the development phase. It is essential that this document be prepared with both clarity and completeness so that it may serve as a model for other CBE systems contemplated elsewhere in the Marine Corps training establishment.

ENABLING TASK NO.: 2.2 PRIORITY: 1

TASK STATEMENT: Determine, design, and document the needs of each of several computer subsystems.

BEGIN: December 1979 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CEB Staff and CSA

REQUIRED EXPERTISE: Levels C and D

We have already commented on the general need for a highly competent, experienced systems analyst to coordinate the design and development of the entire system. That need is manifest in the major modification of the design process. The CBE staff did an excellent job of identifying the major subsystems required, and preparing a well sequenced implementation plan for insuring their development. Unfortunately, experience has shown that all of the subsystems must be designed very nearly at the same time or insurmountable interface problems will eventually surface. The Navy CMI system is a good example of this; failure to anticipate and provide the data-base management needs of the extensive response history files has left these data all but inaccessible for the variety of management and research functions that it is now recognized they should be serving. This is in no way a criticism of the Navy system; it was not designed from the outset to serve these functions, but modifying it now to meet these additional needs is a costly process that should be avoided in the case of the MCCES system.

Problems of this type are easily avoided by designing the major system and its participating subsystems as an integral whole, permitting the solution of interface problems to be accomplished before huge data bases have been accumulated. Accordingly, one of our proposed major modifications to the original

2.2 (continued)

implementation plan becomes apparent when one looks at the time frames for designing the several subsystems described in the following pages: they are all identical! Moreover, the three-month span indicated will, we believe, enable the system to be functioning by the target date of August 1980. This may place severe strain on the resources of the design personnel. If so, the recommendation regarding sacrifice of design criteria for the sake of advancing the date of initial operation should be obvious: don't--the eventual price is unjustified.

The several subsystems described in the following pages are meant only as a suggested constellation that will meet all of the required functions of the envisioned system. This list is not meant to constrain the designers in any way. The eventual list of subsystems may be longer or shorter depending on how various functions are combined; and this, in turn, will depend to some degree on the architecture and operating characteristics of the system that is eventually procured. We offer this list merely to document the fact that provision must be made for the performance of all the functions described; how that is to be best accomplished will be a decision properly made by the consulting systems analyst.

ENABLING TASK NO.: 2.2.1 PRIORITY: 1

TASK STATEMENT: Merge final instructional system requirements with system capabilities enumerated on solicitation document.

BEGIN: December 1979 COMPLETE: December 1979

PERFORMING ORGANIZATION ELEMENT: CSA and CBE staff

REQUIRED EXPERTISE: Level C

This is the initial step in the design of the computer system. Any inabilities of the planned system to meet the requirements of the instructional system must be resolved by either (a) amending the requirement from the instructional side, or (b) amending the contract with the system vendor. The result of this effort will be a specification of the capabilities of the solicited system and how each will serve the various functions identified in the final instructional system statement.

ENABLING TASK NO.: 2.2.2 PRIORITY: 1

TASK STATEMENT: Determine and document requirements for the data base management subsystem.

BEGIN: January 1980 COMPLETE: January 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE staff

REQUIRED EXPERTISE: Levels C and D

Any computer-based instructional system has the potential for generating a very large amount of data, nearly all of it useful in either managing or improving the system. Unfortunately, most designers discover this fact after it is too late to make use of it, and vast quantities of data are either discarded or rendered all but inaccessible by improper data base design and management practices.

In order that the MCCES CBE system might be among the first major systems to avert this difficulty, we are recommending that special care be exercised at this step and that it be accomplished with great thoroughness. We suggest that the staff avail themselves of the experience of other designers and managers of major instructional systems, and heed well their cautions concerning those data base elements that might otherwide be overlooked or neglected. The long term utility of the system will profit immeasurably from extra care taken at this time.

ENABLING TASK NO.: 2.2.3 PRIORITY: 1

TASK STATEMENT: Design the data base management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE staff

REQUIRED EXPERTISE: Level C

This task includes those activities normally associated with the design of a complex computer subsystem.

ENABLING TASK NO.: 2.2.4 PRIORITY: 1

TASK STATEMENT: Determine and document requirements for the course management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE staff

REQUIRED EXPERTISE: Level C

The course management subsystem will perform such functions as: generate class rosters, classify and register students on the basis of information available from the MMS tapes, generate grade reports, and generate course evaluation data. In addition to instructors, users such as staff data analysts should be consulted to determine the nature and frequency of their need for any of the foregoing classes of information.

ENABLING TASK NO.: 2.2.5 PRIORITY: 1

TASK STATEMENT: Design the course management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.6 PRIORITY: 1

TASK STATEMENT: Determine and document requirements for the student management subsystem

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE staff

REQUIRED EXPERTISE: Level C

This subsystem will perform the following functions: (a) determine predicted completion times for each student on each module or unit of training material, (b) track individual student progress through a given course or courses, (c) schedule and assign students to courses or other instructional activities, and (d) generate individual student evaluation reports.

It will undoubtedly be useful at this stage to draw on the experience of individuals actively involved with managing these functions in the Navy and/or Air Force CBE systems to insure that no major functions are neglected.

ENABLING TASK NO.: 2.2.7 PRIORITY: 1

TASK STATEMENT: Design the student management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE staff

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.8 PRIORITY: 1

TASK STATEMENT: Determine and document requirements for the staff management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE staff/CSA

REQUIRED EXPERTISE: Level C

Functions to be performed by this subsystem include generation of staff rosters, scheduling of instructors and support personnel to courses, and instructor evaluation. Complete determination of the requirements for this subsystem may have to await the completion of research on the role and function of the CMI/CAI instructor so that meaningful evaluation procedures can be designed, but provision for this function, as for all other functions, must be made in the initial design stages.

ENABLING TASK NO.: 2.2.9 PRIORITY: 1

TASK STATEMENT: Design the staff management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE staff

REQUIRED EXPERTISE: Level B

ENABLING TASK NO.: 2.2.10 PRIORITY: 1

TASK STATEMENT: Determine and document requirements of the resource allocation subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.11 PRIORITY: 1

TASK STATEMENT: Design the resource allocation subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.12 PRIORITY: 1

TASK STATEMENT: Determine and document requirements of the response history subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level C

This subsystem is at the heart of many management, and virtually all evaluative functions, that will be performed by the system. It provides for the storage and retrieval of the details of each student's interaction with his course(s) and with other facets of the instructional system (judicial boards, etc.). Because not all courses will be fully CAI/CMI, special care must be taken to make the records of those students taking courses having only minimal computer assistance compatible with those of students in the fully implemented CBE courses. A major category of users of the response history subsystem will be members of the research/analysis community; it is anticipated that DoD personnel will avail themselves of the opportunity to query the contents of this subsystem if indeed, as we project, the MCCES CBE system becomes the prototype of its kind in the military community.

ENABLING TASK NO.: 2.2.13 PRIORITY: 1

TASK STATEMENT: Design the response history subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

Because this subsystem is central to so many other functions of the system (see 2.2.12), it is essential that its design facilitate rapid access by the other subsystems. At the same time, this subsystem will generate the largest volume of data per unit time, placing special demands on the data base management capabilities that apply to these data sets. These problems are currently being addressed by individuals in the Military Information and Instructional Systems Activity (MIISA) located at NAS Memphis and it is recommended that their design solutions be consulted.

ENABLING TASK NO.: 2.2.14 PRIORITY: 1

TASK STATEMENT: Determine and document requirements of the instructional management subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/ CSA

REQUIRED EXPERTISE: Level C

The instructional management subsystem performs the basic instructional functions of the CBE system, from the terminal-mediated drill and practice functions characteristic of the full CAI mode, to the lesson assignment, testing, evaluating, remediating, and reassigning functions typical of a CMI system. This subsystem interacts continuously with the response history subsystem and is also the principal interface between the system and the student. For this reason, subsystem reliability is a critical design consideration, to be determined by analysis of student contact frequency and duration, and potential training time losses attendant to subsystem failure.

ENABLING TASK NO.: 2.2.15 PRIORITY: 1

TASK STATEMENT: Design the instructional management system.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.16 PRIORITY: 1

TASK STATEMENT: Determine and document the instructional materials development, editing, and revision subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/ CSA

REQUIRED EXPERTISE: Level C

The essentials of this system are to be provided by the vendor; it is necessary to insure at this step that the needs of the instructional system will be served by the computer system as acquired.

ENABLING TASK NO.: 2.2.17 PRIORITY: 1

TASK STATEMENT: Design the instructional materials development, editing, and revision subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

Provide revisions to the vendor's subsystem that are necessary to accommodate any unique or idiosyncratic features of the lessonware contemplated by the instructional system.

ENABLING TASK NO.: 2.2.18 PRIORITY: 1

TASK STATEMENT: Determine and document the instructional materials evaluation system.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/ CSA

REQUIRED EXPERTISE: Level C

Again, this function is generally served by the vendor's subsystem, but a major elaboration is indicated by experience with both the Air Force and Navy CMI systems. Specifically, in large systems such as those serving training pipelines (sequenced courses) it is both possible and desirable to evaluate portions of the instructional materials in terms of the performance of students in follow-on courses for which the subject materials are prerequisite. This function relies heavily on the response history subsystem and must be planned accordingly; the rapid identification of defective portions of the instructional materials and their prompt removal and/or revision is a function few instructional systems can support, but one which augurs for substantial savings in total throughput time.

ENABLING TASK NO.: 2.2.19 PRIORITY: 1

TASK STATEMENT: Design instructional materials evaluation system.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.20 PRIORITY: 1

TASK STATEMENT: Determine and document requirements for instructional system evaluation subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level C

Formal channels for collecting evaluations of MCCES graduates' performance in the field should be established and a provision made for incorporating these data in a routine evaluation of the entire CBI system. Additionally, the subsystem should routinely report course-to-course performance conditions so that adjustments in beginning course requirements can be made and validated in terms of later achievement.

ENABLING TASK NO.: 2.2.21 PRIORITY: 1

TASK STATEMENT: Design instructional system evaluation subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA/CBE Staff

REQUIRED EXPERTISE: Level C

ENABLING TASK NO.: 2.2.22 PRIORITY: 2

TASK STATEMENT: Determine and document requirements for on-line cost-effectiveness monitoring subsystem

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CAS/CBE Staff

REQUIRED EXPERTISE: Levels C or D

Command personnel responsible for training functions in the military are responsible for maximizing the output of well-trained personnel, while minimizing or maintaining the costs of carrying out this mission. Unfortunately, they seldom have at their fingertips sensitive data on the momentary cost-effectiveness of the systems they command, and are forced to rely on dated information that is often vague and subjective when attempting to isolate the cause of a sudden surge in costs or drop in effectiveness.

The proposed MCCES CBE system, with its complete array of subsystems, could present the first operational solution to the above problem. By identifying the collective sources of training costs and monitoring their levels, and by continuously monitoring the effectiveness of the training system in terms of student achievement and pace, indicators of momentary cost-effectiveness could be compiled and displayed to command personnel on demand. Should an undesirable situation or trend be detected, the system could be systematically queried until the probable source was identified. Implementing this feature, while not essential to the operation of the proposed system, would make the system a prototype with regard to this level of managerial control and would provide a continuous rebuttal to those who persist in the assertion that CBE is less cost-effective than traditional alternatives, and who cite the lack of any systematic

2.2.22 (continued)

cost-effectiveness analysis in support of their position. Because the proposed system is a mix of CBE and conventional procedures augmented by computer management capabilities, a comparison is continuously available and should become part of the information base for informed decision and policy making.

ENABLING TASK NO.: 2.2.23 PRIORITY: 2

TASK STATEMENT: Design on-line cost-effectiveness monitoring subsystem.

BEGIN: January 1980 COMPLETE: March 1980

PERFORMING ORGANIZATION ELEMENT: CSA /CBE Staff

REQUIRED EXPERTISE: Levels C and D

FUNCTIONAL OBJECTIVE: Develop the Computer Software System

ENABLING TASK NO.: 3.0 PRIORITY: 1

TASK STATEMENT: Develop the computer software system necessary to enable the CBE system to perform its intended instructional functions.

BEGIN: July 1979 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff, CSA, and support personnel

REQUIRED EXPERTISE: Levels A, B, C, D. Most of the effort will be provided by programmers on the CBE staff, with direct guidance by the in-house systems analysts and the CAS.

This functional objective is designed to result in the development of the computer software system necessary to support the CBE instructional functions. Completion of this objective involves not only performing and documenting the applications programs, but also developing the system capability of performing appropriate processing functions. Although a straight-forward objective, the work represented by this phase of the plan is crucial to actual operation of the system. The proof of successful conduct of these enabling tasks will be actual operation of the CBE system, scheduled for July 1980. Specification of the COBOL language in the RFP requires the development of application programs in that language. Existing and anticipated programming resources should be able to accomplish this programming activity.

ENABLING TASK NO.: 3.1 PRIORITY: 1

TASK STATEMENT: Identify and train applications programmers.

BEGIN: July 1979 COMPLETE: October 1979

PERFORMING ORGANIZATION ELEMENT: CSA, CBE Staff

REQUIRED EXPERTISE: Level C

It is anticipated that these personnel will be recruited mainly from an available pool of military personnel. Alternatively, if a major contract is let to implement the system design and development phases, the contractor should assume responsibility for performing this step and certifying the competence of each hire to perform the needed programming duties.

ENABLING TASK NO.: 3.2 PRIORITY: 1

TASK STATEMENT: Draft Integrated Logistics Support Plan (I.L.S.P.)

BEGIN: September 1979 COMPLETE: October 1979

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Level A

This step can begin as soon as the instructional system design is completed.

ENABLING TASK NO.: 3.3 PRIORITY: 1

TASK STATEMENT: Revise and submit I.L.S.P.

BEGIN: October 1979 COMPLETE: October 1979

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Level A

ENABLING TASK NO.: 3.4.1 PRIORITY: 1

TASK STATEMENT: Train application programmers to use system acquired in 3.3.1

BEGIN: August 1979 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Level A

ENABLING TASK NO.: 3.4 PRIORITY: 1

TASK STATEMENT: Acquire interactive COBOL capability.

BEGIN: July 1979 COMPLETE: ASAP

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Level A

Specification of COBOL as the computer system language imposes the constraint that all system routines be written in COBOL. For purposes of development, testing, and debugging, a small, interactive microsystem with COBOL capability will greatly accelerate the rate of program development.

ENABLING TASK NO.: 3.4.2 PRIORITY: 1

TASK STATEMENT: Develop programming standards.

BEGIN: July 1979 COMPLETE: August 1979

PERFORMING ORGANIZATION ELEMENT: CBE Staff/ CSA

REQUIRED EXPERTISE: Level C

Detailed guidelines for programmers will ensure that subroutines mesh properly and simplify documentation.

ENABLING TASK NO.: 3.4.3 PRIORITY: 1

TASK STATEMENT: Develop documentation standards

BEGIN: July 1979 COMPLETE: August 1979

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA/Outside Consultant

REQUIRED EXPERTISE: Levels C and D

This step is critical if the system is to have any applicability beyond the boundaries of MCCES and the tour of duty of the original developers. Further, system test and debugging will be greatly facilitated if this step is carefully executed.

ENABLING TASK NO.: 3.4.4 PRIORITY: 1

TASK STATEMENT: Develop system test plan

BEGIN: October 1979 COMPLETE: Ongoing

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CAS

REQUIRED EXPERTISE: Level C

Subsystem tests will be conducted as a routine part of development. Interface tests must be performed as pairs of subsystems become operational and a master plan for documenting the results of these tests is desirable as an adjunct to final system testing and debugging (See Task 3.6).

ENABLING TASK NO.: 3.5 PRIORITY: 1

TASK STATEMENT: Develop subsystems.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: Staff/CSA

REQUIRED EXPERTISE: Levels B and C

Development of several subsystems described in Task 2.1 can and should proceed in harmony with the design process since problems and constraints encountered in the design activity will (must) be accommodated in the development phase. We therefore perceive design and development as essentially contemporaneous. The order of subsystem development tasks contained in the following pages, then, is not an attempt to sequence the developmental effort; rather, it reflects our judgement as to the priorities that should be attached to the various subsystems. Extra care and resources, if available, should be directed to the development of those subsystems appearing early in the sequence.

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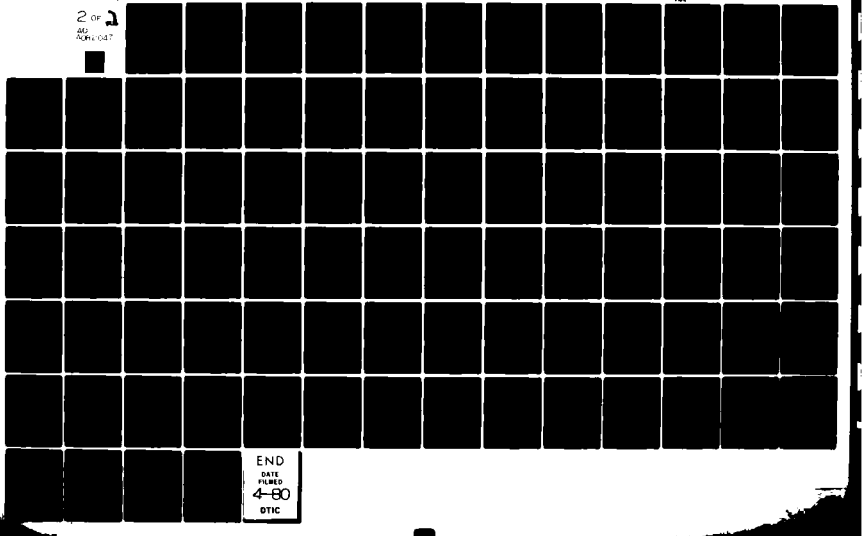

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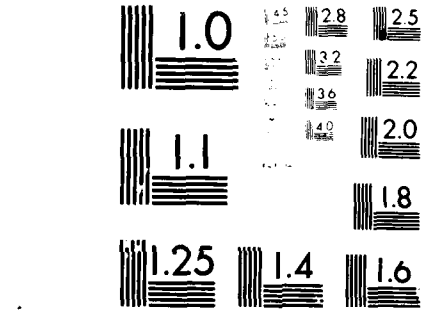

ENABLING TASK NO.: 3.5.1 PRIORITY: 1

TASK STATEMENT: Begin developing data base management subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/ CSA

REQUIRED EXPERTISE: Levels B and C

ENABLING TASK NO.: 3.5.2 PRIORITY: 1

TASK STATEMENT: Develop response history subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Levels B and C

ENABLING TASK NO.: 3.5.3 PRIORITY: 1

TASK STATEMENT: Develop instructional management subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level B, C

ENABLING TASK NO.: 3.5.4 PRIORITY: 1

TASK STATEMENT: Develop student management subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level B, C

ENABLING TASK NO.: 3.5.5 PRIORITY: 1

TASK STATEMENT: Develop Course Management Subsystem.

BEGIN: July 1979 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level B, C

ENABLING TASK NO.: 3.5.5.1 PRIORITY: 1

TASK STATEMENT: Develop MMS tape system.

BEGIN: July 1979 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level A, C

This subobjective combines objectives 6.2.1, 6.2.2 and 6.2.3 of the original MCCES CBE implementation plan and concerns developing system compatibility with the MMS tape system. As such, this function resides in the registration routine of the course management subsystem.

Since accomplishing this objective will depend on cooperative interaction between MCCES and HQMC, it is suggested that efforts are begun now to make the arrangements necessary to insure reliable access to the MMS tapes and that these arrangements be documented and secured. An embarrassing source of system failure and time loss arises when students are forced to wait to register for a course because some element external to the system has failed to perform.

ENABLING TASK NO.: 3.5.6 PRIORITY: 1

TASK STATEMENT: Develop materials development subsystem.

BEGIN: July 1979 COMPLETE: FEB 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/Vendor

REQUIRED EXPERTISE: Level C, D

The timeframe for this subobjective is foreshortened to insure that the instructional materials development personnel have ample time to author and code materials into the CBE system.

ENABLING TASK NO.: 3.5.6.1 PRIORITY: 1

TASK STATEMENT: Develop instructional materials revision system.

BEGIN: July 1979 COMPLETE: FEB 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/Vendor

REQUIRED EXPERTISE: Level B or C

See Task 3.5.6.

ENABLING TASK NO.: 3.5.7 PRIORITY: 1

TASK STATEMENT: Develop resource allocation subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level B or C

ENABLING TASK NO.: 3.5.9 PRIORITY: 1

TASK STATEMENT: Develop instructional materials evaluation subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level B, C

ENABLING TASK NO.: 3.5.10 PRIORITY: 1

TASK STATEMENT: Develop evaluation subsystem.

BEGIN: January 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level B, C

ENABLING TASK NO.: 3.5.11 PRIORITY: 2

TASK STATEMENT: Develop cost effectiveness monitoring subsystem

BEGIN: January 1980 COMPLETE: January 1981

PERFORMING ORGANIZATION ELEMENT: CSA/Consultant

REQUIRED EXPERTISE: Level C, D

The time frame has been expanded on this objective because it cannot be tested until the system is operational and real data are being processed. Reaction to the information yielded by the cost-effectiveness monitoring subsystem can be assessed.

ENABLING TASK NO.: 3.6 PRIORITY: 1

TASK STATEMENT: Test entire system.

BEGIN: July 1980 COMPLETE: ?

PERFORMING ORGANIZATION ELEMENT: CBE Staff/CSA

REQUIRED EXPERTISE: Level C

FUNCTIONAL OBJECTIVE: Operate the CBE System

ENABLING TASK NO.: 4.0 PRIORITY: 1

TASK STATEMENT: Install computer programs and courses onto the system and operate the CBE system.

BEGIN: As early as October 1979 COMPLETE: Through system operational life.

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Levels B, C: Existing CBE staff plus additional computer programmers as scheduled, and with the assistance of the CAS during initial system operation.

This functional objective is the ultimate objective of the entire project, namely the operation of the CE system. Generally, the CBE personnel involved with system design and development will gradually phase the activities outlined under this objective into operation. The early effort focuses on getting the software implemented onto the Vendor's computer system and making sure that all subsystems operate properly. Attention then turns to making the system function instructinally with the implementation of the CAI/CMI courses and students.

ENABLING TASK NO.: 4.1 PRIORITY: 1

TASK STATEMENT: Collect student completion times as individualized materials are validated, for the purpose of building a data base for the student prediction system.

BEGIN: As early as October 1979 COMPLETE: Throughout materials development.

PERFORMING ORGANIZATION ELEMENT: CBE operations staff

REQUIRED EXPERTISE: Level A

A format should be developed for gathering student completion times from the instructional developers as they validate instructional materials beginning with the CCMC course in task 6.1.6. These student study times should also be collected along with the students' aptitude test scores, so they may be placed in the proper computer file when it is operational. These items and aptitude scores will serve as the basis for a data base for generating predicted study completion times when the entire course is operational. The validation times should be collected for each instructional module.

ENABLING TASK NO.: 4.2 PRIORITY: 1

TASK STATEMENT: Staff the CBE operations group fully with all analysts and programmers.

BEGIN: January 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE Staff

REQUIRED EXPERTISE: Level B

At this time all operations staff should be brought aboard. This step is necessary if the computer systems are to be installed in the vendor's equipment and operational by August 1980.

ENABLING TASK NO.: 4.3 PRIORITY: 1

TASK STATEMENT: Train all CBE system operators about operation of vendor's system.

BEGIN: February 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE office

REQUIRED EXPERTISE: Level B

The vendor is to provide training to all CBE system operators on their system's operation. This training must be completed before applications programs can be transferred to the new computer system.

ENABLING TASK NO.: 4.4 PRIORITY: 1

TASK STATEMENT: Install applications programs onto new computer system.

BEGIN: February 1980 COMPLETE: April 1980

PERFORMING ORGANIZATION ELEMENT: CBE System Operators

REQUIRED EXPERTISE: Level B

This work is required to transfer application programs onto the new system by the system operators. It should be anticipated that some programs will require change and debugging during this transfer.

ENABLING TASK NO.: 4.5 PRIORITY: 1

TASK STATEMENT: Begin actual operation of vendor's computer system with system operators testing out various programs.

BEGIN: April 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE System Operators

REQUIRED EXPERTISE: Level B

As the subsystems are installed on the system, they can be independently tested. Nevertheless, testing of the entire system cannot occur until all systems are online and operating.

ENABLING TASK NO.: 4.6 PRIORITY: 1

TASK STATEMENT: Course authors begin coding CCMC instructional material onto the CAI system.

BEGIN: March 1980 COMPLETE: July 1980

PERFORMING ORGANIZATION ELEMENT: Instructional Developers

REQUIRED EXPERTISE: Level B

To make sure that the CAI authoring capability is truly functional, instructional developers should begin coding materials into the system using the six student terminals. This coding task creates the opportunity for further testing of the system with online instruction. CBE system operators and instructional developers will be working closely during this phase until procedures are finalized for course development and implementation.

ENABLING TASK NO.: 4.7 PRIORITY: 1

TASK STATEMENT: Establish administrative procedures for system operators' interaction with other system users, such as instructional developers and training course personnel.

BEGIN: June 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE Operations Staff

REQUIRED EXPERTISE: Level A

This task is necessary to enable members of the training community, including instructional developers, instructors, and training officers to interface with the CBE system. Proper procedures at this time will aid in obtaining acceptance of the operational system and will help to identify possible areas of procedural problems.

ENABLING TASK NO.: 4.8 PRIORITY: 1

TASK STATEMENT: Complete site preparations for CCMC course and all system computer components.

BEGIN: July 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE Operations Staff

REQUIRED EXPERTISE: Level A

If the CCMC course is to be operational, complete with students in August of 1980, the learning centers and computer terminals must be fully installed during July. This will allow one month for removing system problems from the terminal to the computer. It will also allow an opportunity for the CCMC personnel to become adjusted to the CBE system. CCMC staff should not be expected to teach conventional lectures with construction going on around them. System acceptance would be more likely, if the CCMC course were not operating during July, and if the staff were available to assist with restructuring of the classrooms into CBE learning centers.

ENABLING TASK NO.: 4.9 PRIORITY: 1

TASK STATEMENT: Operate the CBE system with the CCMC course and students.

BEGIN: August 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE Operations Staff

REQUIRED EXPERTISE: Level B

This task is what this entire effort is about. What more can be said than what is expressed in the task statement. Good luck!

ENABLING TASK NO.: 4.10 PRIORITY: 3

TASK STATEMENT: Maintain the CBE system with courses and students online.

BEGIN: August 1980 COMPLETE: Through life of the system.

PERFORMING ORGANIZATION ELEMENT: CBE operations staff and vendor maintenance personnel.

REQUIRED EXPERTISE: Level B, D

ESTIMATED COST:

$72,000 for FY 1981, including maintenance and other miscellaneous services.

Maintenance of the CBE system is absolutely vital to system success. If the system is not operational, all benefits will be lost. Even short downtimes are quite disruptive to students engaged in CBE. Although it is difficult to estimate actual maintenance costs before system selection, we feel that the MCCES estimates for maintenance are probably too low. The CBE operations staff needs to monitor maintenance service and costs and make sure that they are adequate to keep the system functional.

FUNCTIONAL OBJECTIVE: Acquire the CBE System

ENABLING TASK NO.: 5.0 (5.1 to 5.10) PRIORITY: 1

TASK STATEMENT: Vendor provides equipment, software, and training as contracted.

BEGIN: June 1979 (a 2-month setback caused by formal delay of proposal submission.) COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Vendors

REQUIRED EXPERTISE: Level D

Since the steps in this functional objective are already specified and dated per the procurement schedule, these enabling tasks are duplicates of those included on the implementation plan developed by the CBE office. Indicated dates are scheduled dates plus two months to allow for the 2-month setback in proposal submission.

5.0 Acquire CBE System

	Enabling Task	Revised Date
5.1	Receipt of vendor proposals Technical Evaluation	June 1979
5.2	Benchmark trips to vendors	August 1979
5.3	Benchmark Evaluation	September 1979
5.4	Contract negotiations	October 1979
5.5	Best and Final Offers	October 1979
5.6	Selection of contractor and award of contract	November 1979
5.7	Vendor training of MCCES personnel	December 1979
5.7.1	Vendor's training of Systems Analyst (6 weeks)	December 1979
5.7.2	Vendor's training of System Operators	February 1980
5.8	Vendor installs system, 4 management terminals, and 6 student terminals	February 1980
5.9	Vendor installs 2 optical mark readers and 125 student terminals	August 1980
5.10	Vendor installs 2 optical mark readers and 116 student terminals	July 1981

FUNCTIONAL OBJECTIVE: Develop Instructional Materials

Develop Instructional Materials

6.0

The purpose of the work for this objective is to develop the instructional materials to be used on the CBE system for both the CAI and CMI modes. Materials for the CAI mode include: the individualized written materials of a narrative, summary, or programmed instruction (PI) nature, along with required illustrations, tables, or alternate media. It is beyond the scope of this analysis to specify in great detail the kinds of material for each course. The materials should be developed following a systematic form of instructional development beginning with the preparation of training objectives with appropriate conditions and standards for performance. For the CBE system implementation, extensive job and training task analyses will not be possible due to the time factor; however, every opportunity should be taken to modify the program of instruction (POI) for each course by incorporating any needed changes that are currently recognized by the training staff. These materials will provide a hard copy backup set of training materials which can be used if the computer system becomes temporarily inoperative.

The materials for the courses to be implemented only in a CMI mode for initial system implementation include only the typical weekly achievement test. Initial demonstration of the CMI capability will require only student registration, automated achievement test scoring, and student tracking capability. The development and implementation of the CMI materials is a considerably smaller task than for CAI, but it is important for ensuring development of the CMI aspect of the system. There are over 40 courses for full CMI implementation, so two man-years effort are devoted to this task for each of four years. It is not possible to estimate with any greater degree of accuracy the time required for the CMI materials development effort until the specific system has been contractually selected.

A crucial issue for life-cycle system cost-effectiveness regards the selection of courses for CAI/CMI implementation. It was decided that course selection should be based on student load factors that would provide ranking factors based on the number of student courseweeks taught per year and total annual students/coursework under current instructional procedures. The following table shows the summary of this analysis with the courses listed in descending order of student-courseweeks, defined as the total number of student-weeks taught each year. This figure is obtained by multiplying the annual student load by the number of current courseweeks. The second ranking factor, annual student/coursework, was obtained by dividing the total annual student load by the course length in weeks. The figures were obtained from MCCES personnel and the MCCES Formal School Schedule. The ranking factors indicate how much training occurs, based on course length. The higher the number, the greater the potential cost-savings.

Annual Student Course-Weeks for MCCES Courses Considered for CBE

Course	Length (wks)	Class Size	Classes/yr	Ranking Factors: Annual Student Times Course-week	Ranking Factors: Annual Student Per Courseweek
1. BEC	10	35	48	16,800	168
2. FROC	7	35	50	12,250	250
3. GRRC	21	22	19	8,778	19/9
4. CCMC	9	32	25	7,200	88.9
5. RF	6	24	24	3,456	96
6. FDLC	2	30	48	3,360	840
7. TTC	16	35	5	2,800	10.9
8. CCCC	10	25	3	750	7.5
9. HFCCOC	4	13	9	468	29.2

Because the annual student-courseweek and total annual students per course week figures diminish so greatly beyond course 6, FDLC, the remaining courses (7-9) were not considered for CAI implementation. There is just not a sufficient number of students per year going through those courses to make them worth the extensive instructional development effort necessary to implement them onto the system. These figures were also used as the basis for recommending the order of course implementation, except that the MCCES indicated that initial implementation should include both a maintenance and an operator course in order to optimize student training time savings. For these reasons the CCMC course was selected as the operator course because it is a course in which graduates go directly to the field rather than being continued into additional courses which could wash away obtained training time savings by having students wait for classes to form. FDLC was selected as the maintenance course for initial implementation because it is short and provides large numbers of graduates after only two weeks training. The order of implementation of remaining courses was determined on the basis of the amount of instructional development work necessary, student load, and whether the course would facilitate movement of the graduating student to the FMF, thereby capturing real training time savings. The following table indicates the recommended CAI course implementation schedule.

Recommended CAI Course Implementation Schedule

1. CCMC - June 1980
2. FDLC - October 1980
3. BEC - July 1981
4. FROC - June 1982
5. RFC - July 1983
6. FRRC - June 1984

It should be noted that courses were not excluded even though they involved relatively large amounts of field-practical work. The course involved, primarily FROC,were determined to be of such a nature that field sites could and should be set up and dedicated for particular exercises and that students could go through those exercises on an individualized basis using CMI for exercise assignment and monitoring. This would require staffing those sites and would require the preparation of written instructions to aid the students in performing the field exercises, but would allow self-pacing to continue to function. It might be appropriate for students to team up for certain exercises. but this peer-learning experience would yield important learning and motivational benefits and would aid the overall individualized learning experience.

To aid in course selection and in development of the implementation plan, the amount of instructional development effort in military man-years was computed. For comparison, the number of civilian man-years required was also estimated. These estimated man-years were converted to dollar costs to aid in planning. The basis for estimating military man-year cost was the average instructor salary of $12,704 per year, while the estimate for a civilian contractor man-year was $37,500.

An additional estimate of the amount of instructional development time per hour of instructional time was necessary for determining development costs. This estimate was the number of authoring and coding hours necessary to convert each hour of conventional instruction to CAI or CMI. For purposes of the recommended implementation plan and for the sensitivity analyses, high, moderate, and low estimates for required time were selected and used. These authoring/coding estimates are presented in the table below.

Selected Authoring/Coding Hour Estimates Per Instructional Hour

	Low		Moderate		High	
	Author	Code	Author	Code	Author	Code
CAI	75	25	100	50	150	75
CMI	75	10	100	20	150	30

The moderate time estimates were used in determining the required development timesand costs,which are included in the recommended implementation plan.

A further important assumption was that all practical or exercise POI hours would be taught using CMI, and that 50% of the knowledge portion of each course would be developed for CAI and the remaining 50% developed for CMI. The decision to base CAI development time for knowledge portions of courses on a 50% ratio was arbitrary, but was predicated on the decision to include six courses for implementation instead of four, thereby resulting in a need for more student terminals than an 85% CAI ratio would permit. Even though contractual specifications limit the acquisition to 260 student terminals, that may well be an adequate number for all six courses given this report's recommendation of only 50% CAI for knowledge POI hours.

The following tabel summarizes POI hours, and estimated required man-years and costs for both civilian and military instructional developers. A military manager was figured on 1,693 hours per year (MCCES hours figure of 1765-72 hours for holidays) and 1,920 hours per year for civilian (40 hours per week times 48 weeks).

Course POI Hours and Estimated Man-years and Costs for Military and Civilian Contractor Instructional Development

Course	POI Hours	Military		Contractor	
		Man-years	Costs	Man-years	Costs
1. CCMC	333	24.5	311.1K	21.7	813.7K
2. FDLC	70	5.3	67.3K	4.7	176.3K
3. BEC	359	27.6	350.5K	24.4	915K
4. FROC	279	20.6	261.6K	18.2	682.5K
5. RFC	222	17.1	217.2K	15.1	566.3K
6. GRRC	704	53.5	679.5K	47.3	1,773.7K

It should be apparent from the figures in the table that development of materials in general is extremely expensive and development of the GRRC course will be the most expensive of all. It was included because it does have a high student annual throughout and will contribute to the overall cost-effectiveness of the CBE system. Obviously, as instructional development resources are limited, GRRC should be the last course to be developed.

Development of the materials is one of the most important activities and is crucial to the success of the system. Well-developed materials will do more for system success than any other area of endeavor except for system design. Therefore, it is our recommendation that instructional materials be developed by contracted professional material developers. Recognizing that funds may not be available for all contractor developed materials, we recommend that the first two courses to be developed, CCMC and FDLC, be

done under contract and then those materials can be used by Marine Corps instructional developers as models for the construction of materials for other courses. In the interest of economy, the man-year and cost estimates for military development were included in the recommended implementation plan, since it was understood at the beginning of this analysis that MCCES was arranging for 32 instructor billets for personnel to serve for four years to prepare materials.

If the necessary funds for contractors or the military billets for developers are not provided, the CBE system will NEVER become operational. To the extent that the funds or billets are only partially provided, then only a portion of the courses can be implemented. Training time savings, hence, cost-effectiveness, can be obtained only by developing and implementing individualized instruction on the CBE system. The importance of the material development task and the development resource requirement can not be underestimated.

Although not a major concern of MCCES, it is common knowledge that all branches of the military, including the Marine Corps are experiencing manpower recruitment problems. The potential impact of professionally developed instructional materials on student morale may be expected to extend into the civilian community; recruits telling their friends that their courses are interesting and exciting could do more for the Corps image than any number of recruiter pep talks or expensive TV commercials.

If a contractor is to be used for development of materials, the contract should be let on a competitive basis. Without competition, the price for contractor developed materials would undoubtedly be higher than necessary for obtaining suitable materials.

The information in the preceding paragraphs has been provided for personnel using the implementation to enable them to perform the necessary calculations for an instructional development cost analysis should situational constraints call for deviation from the recommended course development list. The enabling tasks that are necessary for meeting the instructional materials objective are specified in the following enabling task summary sheets.

FUNCTIONAL OBJECTIVE: Develop Instructional Materials

ENABLING TASK NO.: 6.0 PRIORITY: 1

TASK STATEMENT: Develop individualized instructional materials for CBE system.

BEGIN: August 1979 COMPLETE: When system fully implemented.

PERFORMING ORGANIZATION ELEMENT: Preferred: contract materials developer, but MCCES personnel if necessary.

REQUIRED EXPERTISE: Level D or A: Instructional material development.

ENABLING TASK NO.: 6.1 PRIORITY: 1

TASK STATEMENT: Develop CAI CMI instructional material for Communication Center Main Course (CCMC)

BEGIN: August 1979 COMPLETE: June 1980

PERFORMING ORGANIZATION ELEMENT: ESD instructional developers

REQUIRED EXPERTISE: Level B, but prefer D: E-6 Instructor with knowledge of subject matter area and capable of performing ISD procedures. Ideally this task would be performed by a highly skilled instructional developer under contract to MCCES. Expected civilian cost = 21.7 civilian man-years/$813.7K.

ESTIMATED MILITARY MAN-YEARS: 24.5 ESTIMATED COST: $311.1K

Enabling tasks for development of the first course for CBE implementation include initial tasks which define-individualized materials format and author training. The development for subsequent courses does not include those activities. Separate manning/costs for each subtask are not desirable without extensive ISD planning effort and are beyond the scope of this analysis.

ENABLING TASK NO.: 6.1.1 PRIORITY: 1

TASK STATEMENT: Define format and procedures for developing individualized materials for CAI/CMI.

BEGIN: June 1979 COMPLETE: July 1979

PERFORMING ORGANIZATION ELEMENT: ESD Educational Specialist

REQUIRED EXPERTISE: Level A, or D Must have knowlege of ISD procedures, and be familiar with individualized materials.

This task specifies the format for the CAI materials, building upon experience with programmed instruction. General constraints on media, subject matter experts, and materials must be taken into consideration when specifying the format. Although exact instructional sequencing strategies cannot be specified until contract award, general course sequencing strategies can be defined. Arrangements should be made with Centers graphics department for providing graphics support.

ENABLING TASK NO.: 6.1.2 PRIORITY: 1

TASK STATEMENT: Train M.C. personnel in preparation of CAI materials

BEGIN: July 1979 COMPLETE: August 1979

PERFORMING ORGANIZATION ELEMENT: ESD personnel

REQUIRED EXPERTISE: Level A

ESD personnel will train E-6 instructors who have been selected for instructional development effort. They should be taught how to apply ISD procedures including: writing of training objectives, writing of test items, specification of learning activities, and preparation of narrative, programmed instruction, and summaries of technical instructional material.

ENABLING TASK NO.: 6.1.3 PRIORITY: 1

TASK STATEMENT: Conduct analsis of POI for CCMC

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: MCCES instructional developers

REQUIRED EXPERTISE: Level B

This analysis should include examination of current training objectives in the CCMC POI, and should integrate identified curriculum changes provided by the CCMC training staff from Task 1.2.1. Upon revision of objectives, learning activities should be specified, and test-items which measure achievement of the objectives should be written.

ENABLING TASK NO.: 6.1.4 PRIORITY: 1

TASK STATEMENT: Prepare individualized instructional materials for CCMC.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Instructional materials should be written in both narrative and programmed instruction formats in order to suit different learning styles of students. A summary of material should also be prepared for each module.

ENABLING TASK NO.: 6.1.5 PRIORITY: 1

TASK STATEMENT: Develop graphics material for CCMC

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Base graphics department

REQUIRED EXPERTISE: Level A

Graphics material should be provided back to instructional developers as rapidly as possible to facilitate review and revision, if necessary. It would be expected that most graphics work would require only black and white written materials.

ENABLING TASK NO.: 6.1.6 PRIORITY: 1

TASK STATEMENT: Validate individualized materials for CCMC

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional Developers/CCMC staff

REQUIRED EXPERTISE: Level B

Validate instruction by using approximately 6-10 students from current CCMC class students who have not experienced training in relevant objectives. This CCMC input comes from Task 1.3.1 and should involve individual students for only a day or two at a time. The time that these students require for completing these materials should be measured and reported to the CBE office to aid in developing the student progress prediction capability of the system.

ENABLING TASK NO.: 6.1.7 PRIORITY: 1

TASK STATEMENT: Revise CCMC instructional materials as required.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional Developers

REQUIRED EXPERTISE: Level B

Any necessary revisions in written, programmed, instructional materials or graphics work should be performed at this time. A sufficient number of copies of completed materials should be reproduced for initial operation of course without CAI--computer assistance.

ENABLING TASK NO.: 6.1.8 PRIORITY: 1

TASK STATEMENT: Train instructional developers in Vendor's Author Language

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Education specialists from ESD

REQUIRED EXPERTISE: Level A

This step assumes that education specialists from the ESD department have themselves received the appropriate training from the Vendor representatives, so that the MCCES personnel can provide additional training directly to the MC developers.

ENABLING TASK NO.: 6.1.9 PRIORITY: 1

TASK STATEMENT: Sequence individualized instructional materials according to the strategies specified by the Vendor Author Language.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional Developers

REQUIRED EXPERTISE: Level B

Sequencing of the CCMC materials according to the Author language may take more time than for subsequent courses since it will be the first occasion this task is undertaken. Therefore, this sequencing may result in some additional material revision. Management of practical exercises must be considered in the development of an instructional sequence. Time must be allowed for student relocation from learning center to field instructional sites.

ENABLING TASK NO.: 6.1.10 PRIORITY: 1

TASK STATEMENT: Code CCMC materials onto CAI system

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

The developers must have received the Vendor Author training in order to code the materials onto the system. Since this is the first course to be implemented, this task may require some revision in the materials for success. Coding must include allowance for necessary change from CAI to CMI mode.

ENABLING TASK NO.: 6.1.11 PRIORITY: 1

TASK STATEMENT: Validate CAI materials with CCMC students

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Validation of materials will require that the system be operational for a small sample of students, approximately 6-10. CCMC staff will input students and their perceptions regarding material from Task 1.4.1. Validation should also include verifying the materials'ability to move students from CAI to CMI modes and back.

ENABLING TASK NO.: 6.1.12 PRIORITY: 1

TASK STATEMENT: Revise CAI materials as required.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Course authors must revise the CAI materials based on student performance. This task must be done for this first course, but then it will be done as a scheduled course revision procedure. Course revision should occur approximately every 12-24 months, depending upon available resources. The procedures specified in the Ford Aerospace report of 16 November 1978 may be used as a starting point for developing a decision analysis process for selecting a revision strategy.

ENABLING TASK NO.: 6.1.13 PRIORITY: 1

TASK STATEMENT: Turn CCMC course materials over to school

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

CAI materials should be turned over to CCMC staff, via the CBE operations personnel. Additionally, backup, hard-copy programmed instruction should also be delivered to the CCMC in order to provide the staff with materials in case the computer malfunctions. Assistance should be provided to the staff to aiding the preparation of field sites for particular exercises to be monitored by CMI.

ENABLING TASK NO.: 6.2 PRIORITY: 1

TASK STATEMENT: Develop instructional materials for FDLC

BEGIN: June 1980 COMPLETE: October 1980

PERFORMING ORGANIZATION ELEMENT: Instructional developers; prefer contractors, but plan specifies actions for military developers.

REQUIRED EXPERTISE: Level D preferred, but task can be done by Level B.

ESTIMATED MAN YEARS: 5.3 MMY

The procedures followed in this course development effort should be repeated for all remaining courses to be implemented on the CAI/CMI system.

ENABLING TASK NO.: 6.2.1 PRIORITY: 1

TASK STATEMENT: Train personnel in preparation of instructional materials and Vendor Author language, as required.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

If new personnel are brought in for this development effort, then they must receive the training in materials development and course authoring presented to earlier developers. Probably, some of these individuals will have worked on the CCMC course; they may serve as "Team Leaders" which will enable the training course objectives to be divided into sections so that simultaneous development may be carried out by several teams.

ENABLING TASK NO.: 6.2.2 PRIORITY: 1

TASK STATEMENT: Conduct analysis of the FDLC POI and staff input regarding required changes in the course curriculum.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

This analysis is identical to the analysis performed in Task 6.1.3 where school staff provide training change input via Task 1.2.2. This work is critical to the creation of a course that is directed at the most recent information regarding training objectives.

ENABLING TASK NO.: 6.2.3 PRIORITY: 1

TASK STATEMENT: Develop individualized materials for FDLC and sequence according to Vendor strategy for instructional presentation.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Development of these materials may be different from the CCMC course, since FDLC contains more laboratory work. Management strategies for monitoring students in the laboratory sessions must also be developed. Care must be taken to develop proper student instructions to,insure that students can proceed with laboratory exercises with minimal instructor assistance.

ENABLING TASK NO.: 6.2.4 PE: [illegible] 1

TASK STATEMENT: Develop graphics materials for FDLC

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Base graphic's department

REQUIRED EXPERTISE: Level A

Development of graphics materials should be relatively routine at this point, since a previous course has already been developed and administrative problems presumably will have been resolved.

ENABLING TASK NO.: 6.2.5 PRIORITY: 1

TASK STATEMENT: Validate individualized materials for FDLC

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Validation of written individualized materials should be completed using input from the FDLC staff and approximately 6-10 students, via Task 1.3.2. Any revision should be accomplished during this task.

ENABLING TASK NO.: 6.2.6 PRIORITY: 1

TASK STATEMENT: Code materials into CAI system using Vendor Author Language.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Course coders should be well trained at this point and the materials should be coming out of the development phase closer to a final acceptable format.

ENABLING TASK NO.: 6.2.7 PRIORITY: 1

TASK STATEMENT: Implement individualized materials and system into the FDLC course.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

FDLC instructional materials should be turned over to course personnel. Assistance from CBE operations personnel should be provided to the staff to assist them in learning the materials and CAI system. Additional assistance should be made available to ensure that the staff can manage the transitions from CAI to CMI and from knowledge to laboratory sections of the course.

ENABLING TASK NO.: 6.2.8 PRIORITY: 1

TASK STATEMENT: Revise FDLC individualized materials in accordance with normal MCCES policy about course changes.

BEGIN: COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Instructional development

REQUIRED EXPERTISE: LEVEL A

Revision of materials should be performed on a 12-24 month basis, depending upon resource availability. It would be expected that normal billeted MCCES personnel in the ESD department would perform the revision, relying on input from the course staff via Task 1.5.2.

ENABLING TASK NO.: 6.3 through 6.6. PRIORITY: 3

TASK STATEMENT: Develop the instructional materials for remaining courses to be implemented upon CAI/CMI system

BEGIN: COMPLETE: Insructional developers

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Sub-tasks under Enabling Objective 6.2 should be repeated for each additional course. These sub-tasks include: course analysis, material development, validation, coding, and turning materials over to the course staff. As each course is implemented, procedures will become more effective and streamlined. If contractor support has been provided for developing the CCMC and the FDLC courses, then those materials should be used as models for development of other courses by Marine Corps personnel.

ENABLING TASK NO.: 6.3 PRIORITY: 3

TASK STATEMENT: Develop material for BEC

BEGIN: June 80 COMPLETE: July 81

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

ESTIMATED MAN YEARS: 27.6 MMY

ENABLING TASK NO.: 6.4 PRIORITY: 3

TASK STATEMENT: Develop material for FROC

BEGIN: July 1981 COMPLETE: June 1982

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

ESTIMATED MAN YEARS: 20.6 MMY

ENABLING TASK NO.: 6.5 PRIORITY: 3

TASK STATEMENT: Develop materials for RFC

BEGIN: July 1981 COMPLETE: July 1983

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

ENABLING TASK NO.: 6.6 PRIORITY: 3

TASK STATEMENT: Develop materials for GRRC

BEGIN: June 1982 COMPLETE: June 1984

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

ESTIMATED MAN YEARS: 53.5

ENABLING TASK NO.: 6.7 PRIORITY: 1

TASK STATEMENT: Development of CMI materials for courses to be implemented on CMI system only.

BEGIN: October 1980 COMPLETE: August 1984

PERFORMING ORGANIZATION ELEMENT: Instructional developers

REQUIRED EXPERTISE: Level B

Courses that are to remain in lecture form, but are to be implemented on CMI for testing and management should be selected and have respective course staff provide the necessary test items and course description for proper coding into the CBE system. Instructional developers would be expected to code tests into the CMI system with course staff providing any requirements for test change or course sequence change. As development resources are made available, these lock-step courses should be converted to full CAI/CMI presentation. This conversion would not be expected to occur prior to August 1984. Exact estimates of the level of effort required for this enabling task cannot be specified at this time.

ENABLING TASK NO.: 6.8 PRIORITY: 3

TASK STATEMENT: Revise course materials for CBE courses according to MCCES policy

BEGIN: As required COMPLETE:

PERFORMING ORGANIZATION ELEMENT: ESD

REQUIRED EXPERTISE: Level A

Revision of materials should be conducted according to standard Marine Corps policy, approximately every 12-24 months, depending upon resource availability.

FUNCTIONAL OBJECTIVE: Train CBE System Instructors

ENABLING TASK NO.: 7.0 PRIORITY: 1

TASK STATEMENT: Train personnel to assume the role of instructor in the CBE system.

BEGIN: Sept 1979 COMPLETE: Continuing

PERFORMING ORGANIZATION ELEMENT: CBE office and ESD department.

REQUIRED EXPERTISE: Level: A and D for development of training materials.

CMI instructor role training materials need to be developed and implemented into the instructor training program at MCCES. Because of the new nature of this system, development of the instructor training materials should be done by an outside organization experienced with this activity. Availability of a planned R&D contract with McDonnell-Douglas Corporation to develop a CMI instructor role model for the Navy, Air Force and the Marine Corps systems should be used to obtain the CMI instructor job specification.

ENABLING TASK NO.: 7.1 PRIORITY: 1

TASK STATEMENT: The CBE office should input into the McDonnell-Douglas CMI Instructor Role R&D project to make sure that the idealized role model developed by the contractor can be best suited for the proposed Marine Corps CBE system.

BEGIN: Sept - Dec 1979 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE office/training personnel

REQUIRED EXPERTISE: Level A

This task will serve to inform the contractor of the expected dimensions of the MCCES CBE system and the functional activities that will be expected of the CBE system instructor.

ENABLING TASK NO.: 7.2 PRIORITY: 1

TASK STATEMENT: Receive the general CMI instructor role model from McDonnel-Douglas and the job specification for the MCCES CBE system.

BEGIN: Jan 1980 (assuming contract is let as scheduled.) COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CBE office/ESD department

REQUIRED EXPERTISE: Level A

This task is necessary to obtain the job specification and verify it against the CBE system as it has been developed. Receipt of the materials of the indicated data is dependent upon the contract being let as scheduled.

ENABLING TASK NO.: 7.3 PRIORITY: 1

TASK STATEMENT: Develop the CMI instructor training package.

BEGIN: Jan-June 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Contractor, NPRDC could monitor.

REQUIRED EXPERTISE: Level D: Expertise in developing instructor training materials, preferably for computer-based instructional systems.

ESTIMATED MAN YEARS: 1 ESTIMATED COST: $35K

This CMI instructor training material development effort will rely upon obtaining the MCCES CMI Instructor job specification from the McDonnell-Douglas contract. Completion of training materials development could occur approximately 6 months after receipt of the instructor job specification. An initial try-out of the materials would be conducted during the expected 6 month development period.

ENABLING TASK NO.: 7.4 PRIORITY: 1

TASK STATEMENT: Train a sample of MCCES personnel to the CMI instructor role job specification.

BEGIN: Training is expected to take one week, (July 1980, if contract is let on scedule). COMPLETE:

PERFORMING ORGANIZATION ELEMENT: Contract organization that developed training materials.

REQUIRED EXPERTISE: Level D

This activity would be part of the CMI instructor training materials development effort. It would serve as a test of the training materials, but would not have the benefit of indicating how the instructors actually performed. That would occur once the CCMC course was implemented.

ENABLING TASK NO.: 7.5 PRIORITY: 1

TASK STATEMENT: Implement trained instructors into the CCMC course.

BEGIN: August 1980 COMPLETE:

PERFORMING ORGANIZATION ELEMENT: CCMC personnel

REQUIRED EXPERTISE: Level A

Personnel trained in the CMI instructor role would be assigned to the new CCMC course taught by CAI/CMI. The effectiveness of the instructor training would be determined by the adequacy of the instructors serving in CCMC. Since the technical course is also new, it would not be possible to assign all effects to either the instructor training, or the effectiveness of the CBE system and instructional materials.

ENABLING TASK NO.: 7.6 PRIORITY: 3

TASK STATEMENT: Select instructors and conduct CMI instructor training as required for new CBE courses.

BEGIN: As required COMPLETE:

PERFORMING ORGANIZATION ELEMENT: ESD/instructor training personnel.

REQUIRED EXPERTISE: Level A

CMI instructor training should become a part of the normal instructor training activities in MCCES, providing instruction for those individuals selected for duty in the CBE system courses. Although it is assumed that selection procedures for CBE instructors will be the same as those now used for lecture instructors there may be better selection methods. Determination of better instructor selection methods remains to be done. What is not assumed is that there will be the same number of instructors for each course under CME as are now assigned. It is necessary to have some guidelines for determining the CBE instructor requirement. The following guidelines were used in determining the estimated instructor requirement for the recommended CBE system and should be used in actual instructor assignment until better guidelines are developed. In general, portions of courses that are of a knowledge acquisition nature require instructors on the basis of 30 students per instructor in a CMI learning center. Practical portions of CBE courses are to be operated with student/instructor ratios of 10 students per instructor. This higher ratio depends upon well-developed instructional materials to guide each student in the particular exercise or laboratory experiment he is working on. The application of these ratios to the respective proportion of each course selected for

CAI or CMI, with an allowance for courses having field exercises, results in the following instructor requirements. Current course instructor requirements, as provided by CBE staff, are included to indicate the potential savings in instructor personnel. It should be remembered that some instructor reductions are off-set by increases in CBE staff.

Course	Current Lecture Instruction	CBE	Number Reduced
CCMC	14	10	4
FDLC	5	3	2
BEC	29	22	7
FROC	30	22	8
RFC	15	9	6
GRRC	22	15	7
	115	81	34

APPENDIX B

LIST OF TECHNICAL AND COST DATA ELEMENTS

LIST OF TECHNICAL AND COST DATA ELEMENTS

Prior to visiting MCCES in March 1979 the following list of technical and cost data elements was developed to identify types of information necessary for cost estimating purposes. Ideally, data sets for each of these elements would be available to support total life cycle costing of alternative methods of instruction. In reality, limited data were available on specific CI course costs for all the elements listed. On the casis of a one-week visit to MCEES and liaison with MCCES personnel, the availability of information for each cost element was judged to be: a = adequate; b = inadequate; or c = not available. Inadequate implies that cost and technical factors were not readily available, but could be developed with varying degrees of effort from raw data which were accessible.

A list of cost and technical elements follows:

Course Number and Title of Courses Considered for CBE[a]

Length of Training by Course Number and Title[a]

Total Cost of Training by Course Number and Title[b]

Student Load: The average number of students in training who must be instructed, supervised, and otherwise supported.[a]

Student-Instructor Ratio (Students per Instructor)[a]

Student Turnover: The rate of flow considering variable course lengths; impacts staffing for personnel administration and processing, student supervision and transportation.[b]

Attrition Rates by Course[c]

Student Paygrade by Course[b]

Number and Average Grade of Instructor Personnel by Course[b]

Total Twentynine Palms Training Requirements[a]

Instructional System Design Costs[b]

Courseware Development Costs[b]

- Instructional hours developed; cost per manyear (consider direct and indirect costs such as: personnel costs associated with course authoring, coding and task analyses; supplies/consumables; overhead, printing costs, etc.)
- Course Revision Costs
- Task Analyses

Instructional Equipment Costs (specify quantity and unit cost)[c]

- Audio/Visual Aids
- Programmed Texts
- Test Materials
- Optical Mark Readers
- Carrels
- Other (list lab equipment used for hands-on training)[b]

Computer Hardware (specify configuration, quantity and unit cost)[b]

Computer Software Development Costs[b]

Computer Facilities Modification Costs (sunk costs)[b]

Computer Operation & Maintenance Costs[b]

- Personnel Costs (system analysts, engineers, programmers, computer operators, keypunch)
- Maintenance Costs

Instructor Training Costs (course costs)[b]

Manpower Staffing Studies; cost of[c]

CBE Supplies/Consumables; cost of[a]

Travel Costs (Student and Staff)[b]

CBE Contractual Services (describe services; contract costs)[b]

Base Support Costs[b]

- Personnel processing and administration
- Housing
- Food services
- Fire/police protection
- Medical services
- Legal services

Personnel Processing/Administration; cost of[b]

Overhead Costs[b]

- Command
- Administration

APPENDIX C

SUPPORTING INFORMATION FOR

IMPLEMENTATION PLAN AND ECONOMIC ANALYSIS

Table C-1

CBE Program of Instruction
Conversion Hours by Course

Course	POI Hours	Knowledge-Related POI Hours	Performance-Related POI Hours	CBE Conversion Hours	
				CAI[a]	CMI[b]
CCMC	333	93	240	46.5	286.5
FDLC	70	38	32	19	51
BEC	359	241	118	120.5	238.5
FROC	279	92	187	46	233
RFC	222	144	78	72	150
GRRC	704	408	296	204	500
Total	1967	1016	951	508	1459

[a]Based on conversion of 50 percent of knowledge-related POI hours to CAI.

[b]Based on conversion of all performance-related POI hours, plus 50 percent of knowledge-related POI hours, to CMI.

Table C-2

Course Implementation Sequence by Fiscal Year

Course	Months	FY79	FY80	FY81	FY82	FY83	FY84
CCMC	11	Aug 79 Sep 79	Oct 79 Jun 80				
FDLC	5		Jun 80 Sep 80	Oct 80			
BEC	14		Jun 80 Sep 80	Oct 80 Jul 81			
FROC	12			Jul 81 Sep 81	Oct 81 Jun 82		
RFC	25			Jul 81 Sep 81	Oct 81 Sep 82	Oct 82 Jul 83	
GRRC	25				Jun 82 Sep 82	Oct 82 Sep 83	Oct 83 Jun 84

Table C-3

Student Flow Scenarios by Course

Course	Student Entries[a]		Student Flow	Estimated Student Pay Grade Distribution[b]					
	High Flow	Low Flow		E-1	E-2	E-3	E-4	E-5	E-6
CCMC	802	750	High	328	424	34	14	2	--
			Low	307	396	32	13	2	--
BEC[c]	1481	1419	High	569	840	31	16	24	1
			Low	545	804	30	16	23	1
FROC	1720	1155	High	1060	643	15	2	--	--
			Low	711	432	10	2	--	--
RFC	576	480	High	6	364	139	12	36	19
			Low	5	303	116	10	30	15
GRRC	418	376	High	2	214	171	10	19	2
			Low	1	193	154	9	17	2
Total	4997	4180							

[a]The number of students entering training were extracted from MCCES Formal School Schedules for the period FY7T-80. Estimates of high/low student entries were developed by taking the highest and lowest numbers of students that entered or are programmed to enter training during this time period. In FY77-78, for example, 750 students entered CCMC (low value); whereas, in FY79, 802 students (high value) were scheduled to enter CCMC.

[b]Based on an estimated distribution of students by pay grade in each course between October 1978 through February 1979.

[c]FDLC has been incorporated into the BEC course; therefore, the number of student entries for BEC is used.

Table C-4

Annual CI Student Personnel Costs by Course
for High/Low Student Flow Scenarios

Course	Student Flow	E-1	E-2	E-3	E-4	E-5	E-6	Total
CCMC	High	$383,878	$ 545,917	$ 46,842	$22,040	$ 3.642	$ —	$1,002,319
	Low	359,301	509,866	44,087	20,466	3,642	--	937,362
FDLC	High	147,986	240,341	9,491	5,597	9,713	489	413,617
	Low	141,744	230,040	9,185	5,597	9,308	489	396,363
BEC	High	739,928	1,201,704	47,455	27,987	48,564	2,443	2,068,081
	Low	708,718	1,150,202	45,924	27,987	46,541	2,443	1,981,815
FROC	High	964,897	643,913	16,073	2,449	--	--	1,627,332
	Low	647,209	432,613	10,717	2,449	--	--	1,092,988
RFC	High	3,901	260,369	106,391	10,495	36,423	23,209	440,788
	Low	3,251	216,736	88,786	8,746	30,353	18,323	366,195
GRRC	High	5,202	612,297	523,534	34,184	76,893	9,772	1,262,682
	Low	2,601	552,212	471,486	31,486	68,799	9,772	1,136,356
Total	High							$6,814,819
	Low							5,911,079

Table C-5

CI Student Personnel Costs Incurred During CBE Conversion by Course and Student Flow Scenario, FYs 80-84

Course	Student Flow	Annual CI Student Personnel Cost Factor ($)	CI Student Personnel Costs ($) FY80	FY81	FY82	FY83	FY84	Total
CCMC	High	1,002,319	668,213					668,213
	Low	937,362	624,908					624,908
FDLC	High	413,617	413,617					413,617
	Low	396,363	396,363					396,363
BEC	High	2,068,081	2,068,081	1,551,061				3,619,142
	Low	1,981,815	1,981,815	1,486,361				3,468,176
FROC	High	1,627,332	1,627,332	1,627,332	1,084,888			4,339,552
	Low	1,092,988	1,092,988	1,092,988	728,659			2,914,635
RFC	High	440,788	440,788	440,788	440,788	330,591		1,652,955
	Low	366,195	366,195	366,195	366,195	274,646		1,373,231
GRRC	High	1,262,682	1,262,682	1,262,682	1,262,682	1,262,682	841,788	5,892,516
	Low	1,136,356	1,136,356	1,136,356	1,136,356	1,136,356	757,571	5,302,995
Total	High	6,814,819	6,480,713	4,881,863	2,788,358	1,593,273	841,788	16,585,995
	Low	5,911,079	5,598,625	4,081,900	2,231,210	1,411,002	757,571	14,080,308

Table C-6

[illegible] Student Personnel Costs by [illegible], FY80-89: Low Student Flow Scenario

[illegible]	[illegible]	FY80	FY81	FY82	FY83	FY84	FY85	FY86	FY87	FY88	FY89	Total
[illegible]	[illegible]	$249,963	$749,890	$749,890	$749,890	$749,890	$749,890	$749,890	$749,890	$749,890	$749,890	$[illegible]
	[illegible]	[illegible]	637,406	637,406	637,406	637,406	637,406	637,406	637,406	637,406	637,406	[illegible]
	[illegible]	[illegible]	56,047	56,047	56,047	56,047	56,047	56,047	56,047	56,047	56,047	[illegible]
[illegible]	[illegible]	--	317,090	317,090	317,090	317,090	317,090	317,090	317,090	317,090	317,090	[illegible]
	[illegible]	--	269,527	269,527	269,527	269,527	269,527	269,527	269,527	269,527	269,527	[illegible]
	[illegible]	--	221,963	221,963	221,963	221,963	221,963	221,963	221,963	221,963	221,963	[illegible]
[illegible]	[illegible]	--	396,963	1,585,852	1,585,852	1,585,852	1,585,852	1,585,852	1,585,852	1,585,852	1,585,852	[illegible]
	[illegible]	--	336,909	1,347,634	1,347,634	1,347,634	1,347,634	1,347,634	1,347,634	1,347,634	1,347,634	[illegible]
	[illegible]	--	277,455	1,109,816	1,109,816	1,109,816	1,109,816	1,109,816	1,109,816	1,109,816	1,109,816	[illegible]
[illegible]	[illegible]	--	--	291,463	874,390	874,390	874,390	874,390	874,390	874,390	874,390	[illegible]
	[illegible]	--	--	247,734	743,202	743,202	743,202	743,202	743,202	743,202	743,202	[illegible]
	[illegible]	--	--	204,024	612,073	612,073	612,073	612,073	612,073	612,073	612,073	[illegible]
[illegible]	[illegible]	--	--	--	73,239	292,956	292,956	292,956	292,956	292,956	292,956	[illegible]
	[illegible]	--	--	--	62,253	249,013	249,013	249,013	249,013	249,013	249,013	[illegible]
	[illegible]	--	--	--	51,267	205,069	205,069	205,069	205,069	205,069	205,069	[illegible]
[illegible]	[illegible]	--	--	--	--	303,025	909,075	909,075	909,075	909,075	909,075	[illegible]
	[illegible]	--	--	--	--	257,574	772,722	772,722	772,722	772,722	772,722	[illegible]
	[illegible]	--	--	--	--	212,120	636,359	636,359	636,359	636,359	636,359	[illegible]
Total	[illegible]	$249,963	$1,463,343	$2,943,895	$3,600,061	$4,122,806	$4,728,893	$4,728,893	$4,728,893	$4,728,893	$4,728,893	[illegible]
	[illegible]	212,469	1,243,842	2,502,311	3,060,052	3,504,350	4,019,334	4,019,334	4,019,334	4,019,334	4,019,334	[illegible]
	[illegible]	174,974	1,024,341	2,060,726	2,520,062	2,885,890	3,311,775	3,311,775	3,311,775	3,311,775	3,311,775	[illegible]

Table C-7

[illegible] Student Personnel Costs by Course, FY80-89: High Student Flow Scenario

Course	[illegible] Course Length	[illegible]	FY81	[illegible]	FY83	FY84	FY85	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	$801,855	$801,855	$801,855	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	681,577	[illegible]	681,577	681,577	681,577	681,577	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	157,100	561,299	[illegible]	561,299	[illegible]	561,299	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	330,894	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	281,260	[illegible]	281,260	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]		231,626	[illegible]	[illegible]	231,626	231,626	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]	[illegible]	1,654,465	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]		289,531	[illegible]	[illegible]	[illegible]	1,158,125	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
						[illegible]	707,1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table C-9

CBE Section Costs, FYs 1979-81

Cost Element	FY79	FY80	FY81[a]
Military Personnel Services	$158,509	$158,509	$158,509
Civilian Personnel Services	82,285	82,285	82,285
Supplies	4,900	6,700	29,700
Purchased Services[b]	9,000	13,300	72,000
Total	$254,694	$260,794	$342,494

[a]Estimated FY81 costs of supplies and purchased services are based on budget projections developed by the CBE Section.

[b]Purchased services include computer-leased maintenance, telephones, etc.

Table C-10

CBE Course Development Material Costs by Course, FYs 1979-84[a]

Course	Man-hour Conversion Factor	FY79	FY80	FY81	FY82	FY83	Total
CCMC	Low	$374	$1,682				
	Moderate	533	2,400				
	High	800	3,597				
FDLC	Low		353	$ 88			
	Moderate		353	127			
	High		762	191			
BEC	Low		655	1,637			
	Moderate		946	2,365			
	High		1,419	3,552			
FROC	Low			433	$1,298		
	Moderate			618	1,855		
	High			927	2,780		
RFC	Low			170	679	$ 566	
	Moderate			245	980	816	
	High			425	1,700	1,416	
GRRC	Low				713	2,140	$1,605
	Moderate				1,027	3,082	2,312
	High				1,541	4,624	3,468
Total	Low	$374	$2,690	$2,328	$2,690	$2,706	$1,605
	Moderate	533	3,854	3,355	3,682	3,898	2,312
	High	800	5,778	5,088	6,021	6,040	3,468

[a]Limited data provide an inexact basis for estimating material cost; that is, cost estimates may not be reliable enough for budgeting purposes. Based on the cumulative data for FY76/77-78, the ratio of material costs to military man-years for similar courses being developed/revised by Navy instructional program development centers a cost factor of $120 per man-hour is used. Source data used to develop this cost factor were extracted from N423:WEN: vm CNET ltr of 25 Jan 79 "Instructional Program Development (IPD) Cost Report for December 1978."

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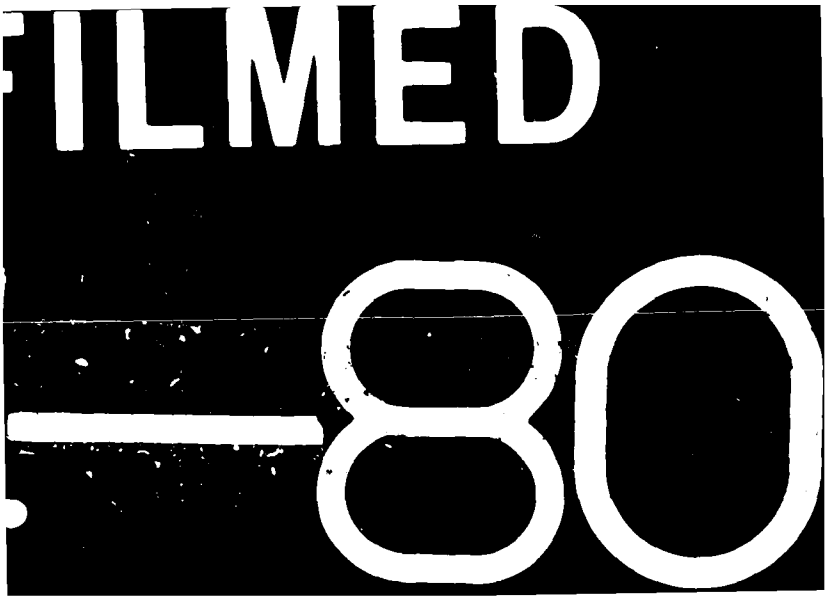
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